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THE

AMERICAN NATURALIST

VOL. XXV. JULY, 1891. 295.

A REVIEW OF THE "DISCOVERY OF THE CRETACEOUS MAMMALIA."[1]

BY HENRY FAIRFIELD OSBORN.

IN July, 1889, I received a copy of the "Discovery of the Cretaceous Mammalia"[2] from Professor O. C. Marsh, and shortly afterwards wrote to the author calling attention to all the points in which it appeared to me he was mistaken, and suggested that he should revise the paper himself.

This was a year and a half ago. In the meantime Parts I. and II. of the "Cretaceous Mammalia" have been widely distributed, and the discoveries have been accepted without question by many who have no special knowledge of the Mesozoic mammals, and with considerable hesitation and criticism by those who have; I refer especially to the notices by Lydekker,[3] Lemoine,[4] Cope,[5] and Dames[6] It seems, therefore, that it is important to carefully review, in a manner that cannot be misunderstood either by the author or by others, what appears to me to be one of the most

[1] Presented to the Society of Morphologists, Boston, Dec. 30th, 1890; Academy of Natural Sciences, Philadelphia, Jan. 20th, 1891; Biological Society of Washington, Feb. 6th, 1891. Printed, with some alterations, in Proc. Phila. Acad.

[2] "Discovery of the Cretaceous Mammalia." O. C. Marsh, *American Journal of Science and Arts*, Parts I. and. II., July and August, 1889.

[3] Manual of Paleontology, Vol. II., p. 1268.

[4] Academy of Sciences, Paris, March 3d, 1890.

[5] AMERICAN NATURALIST, June, 1889, p. 490.

[6] *Neues Jahrb. f. Geol. Min. u. Pal.*, 1890, p. 141–143.

Mo. Bot. Garden,
1895.

remarkable contributions to paleontology ever published. Criticism can, of course, be based only upon the published diagnoses, descriptions, and figures in comparison with our present general knowledge of these early mammals. Other evidence is promised by the author, and I venture to predict that it will confirm the greater part of the conclusions reached in this review.

First, as to extent and general character. The conspectus of the author impresses us that this fauna is not only highly varied, but contains forms which are mostly new to science. Four orders are believed to be represented: the Allotheria, Pantotheria, Marsupialia, and Insectivora. The author finds six families among the Allotheria alone, four of which are new; five new families in all. Sixteen new genera and twenty-seven new species are described. All of the types are isolated teeth, excepting those of Camptomus. With the exception of Halodon, Cimolomys, and Dipriodon, only one tooth of each species is described,—*i. e.*, from different parts of the jaws,—and we are given to understand that the remaining teeth, found with each, will be described in the memoir now in preparation by the writer, under the auspices of the United States Geological Survey.

Before this varied fauna is generally adopted in paleontological literature, let us examine the author's types and diagnoses, keeping in mind some of the characteristics of his work. These are: First, as regards other authors, not fully recognizing priority of discovery and nomenclature. Second, not taking advantage of readily available previous literature and description. Third, failing to recognize well-determined morphological characters, and founding extensive taxonomic systems upon various portions of the same animal, or upon imperfectly characterized types. The very fact that this work is done under the auspices and with the support of the National Survey renders it the more necessary to subject it to a full and fair spirited criticism; for the first characteristic of such work should be, not novelty, but permanent value.

Priority of Discovery and Nomenclature.—It is evident that the same fact cannot be discovered twice, in case the original discovery is authentic and properly published. It is well known

that Mr. J. L. Wortman discovered the first remains of Cretaceous Mammalia in 1882, a fact recorded by Professor Cope, as below:

"Mammalia, which have been looked for so long in vain in the Laramie beds, have at length been found. Mr. J. L. Wortman . . . now announces that he has found them in place and mingled with Dinosaurian remains in such a manner as to leave no doubt as to their contemporaneity." — AMER. NAT., Oct., 1882, p. 830.

"It has long been a reproach to paleontology that no remains of mammals were known from the Cretaceous formation. . . . For many years, therefore, special search has been made in various countries for Cretaceous mammals, but thus far almost invariably without success. . . . A second announcement was made by Cope in 1882, based upon a few fragmentary remains discovered by Dr. J. L. Wortman in Dakota. These fossils, although not found in place, were apparently from the Laramie formation." — *American Journ. of Science and Arts*, July, 1889, p. 81.

These papers under review amply confirm Mr. Wortman's discovery by describing many remains of the same mammal. Nevertheless the original discovery is made to appear very unimportant by depriving the mammalian type of its name. This type was a molar tooth, described as follows:

"*Meniscoëssus conquistus*, gen. et sp. nov.—But one specimen of this animal was found, and that is represented by two *molar* teeth and a distal extremity of a humerus. Were it not for the associated molar tooth, I should think that the *second* tooth might be that of a herbivorous reptile. It is probably a fourth

"It is now known that the tooth first described, and regarded as a premolar, is the tooth of a Dinosaurian reptile, as suggested by Cope, and not of a mammal. The name given, therefore, must apply to this alone. On this point the rules of nomenclature are clear and decisive. The imperfect molar

premolar. . . . *Char. gen.*—Fourth premolar with a compressed antero-posterior edge, which is studded with denticles; sides without ridges. Posterior molar rather small; crown with three longitudinal series of tubercles, of which many have crescentic sections." — AMERICAN NATURALIST, *loc. cit.*, p. 830.

tooth subsequently described and the fragment of a humerus are evidently mammalian, but *without a name*." — *American Journal Science and Arts, loc. cit.*, p. 82.

It is very clearly stated by Prof. Cope in the above description and context that the first tooth—*i. e.*, the true molar—is the one upon which the mammalian determination is based; and that the *second* tooth—*i. e.*, the premolariform one—would have been considered reptilian except for its association with the first. This was clear to Lydekker, Lemoine, Osborn, and all subsequent writers, being repeated later with emphasis by Prof. Cope (AMER. NAT., July, 1884, p. 693).

FIG. 1.—*Meniscoëssus conquistus* Cope. Type. An inferior molar; x 2.

Previous Literature and Description.—There are obvious advantages in not consulting and referring to previous literature. It leaves the mind of a writer unprejudiced by previous opinions, and moreover lends to a contribution a quality of independence and originality. On the other hand, it deprives him of the benefit of past careful and laborious studies, and leads him into errors which might easily be avoided.

In case of the papers under review, previous literature has apparently escaped the attention of the author, except in the matter of nomenclature. The result is that some well-known principles which govern the extremely complex and confusing dentition of the Multituberculates are left out of consideration entirely, as well as some of the main characters of the dentition of the Mesozoic mammals in general, and some characters which enable us to distinguish between the teeth of mammals and those of reptiles and fishes. As regards the Multituberculates (Allotheria), it is now well known that their teeth show the following characters:

1. In the true molars, the rows of tubercles of one jaw fit into the longitudinal grooves of the other jaw. 2. In some families there are three rows of tubercles and two grooves in the upper molars, and two rows with one groove in the lower molars (Plagiaulacidæ); in other families there are conversely two rows above and three below (Stereognathidæ). 3. In every known species the last molar is invariably simpler than the penultimate molar, both as to length of crown and number of tubercles. 4. That the premolars are of two types: *a*, trenchant; *b*, tubercular. When tubercular, they can be distinguished from the molars by the absence of grooves, or closures of the grooves by tubercles. 5. The primary function of the incisors is to pierce the food; the secondary function is to facilitate the backward motion of the jaws, as in the rodents.

As regards the ordinal terms, Allotheria and Pantotheria, they have not as yet been defined or adopted.[7] The former is equivalent to the Multituberculata, which has been defined and is now in general use;[8] the latter is only used by the author in the reference of one genus.

A.—MULTITUBERCULATE FORMS (ALLOTHERIA).

1. *Cimolomys gracilis* (Pl. II., Figs. 1–4). Described as an upper molar; first referred to Tritylodontidæ (Owen), subsequently to new family Cimolomidæ.—Comparing this type with the upper molar of Neoplagiaulax,[9] Lemoine, we find it is a first upper molar of one of the Plagiaulacidæ Gill.

2. *Cimolomys bellus* (no figure). The type is referred to a distinct species of Cimolomys.—The description and measurements indicate that it is a second upper molar of *C. gracilis.*

3. *Cimolomys digona* (Pl. VII., Figs. 1–4). The type is described as an upper molar of a third species of this genus, referred to the Cimolomidæ.—It is an upper molar of one of the Plagiaulacidæ.

[7] See Osborn. "Mesozoic Mammalia," p. 257. The objections to Allotheria are that the term implies a sub-class equivalent in importance to the Prototheria or Eutheria, while the definition proposed by Professor Marsh is applicable to the *family* Plagiaulacidæ.

[8] See the works of Lydekker, Döderlein, Trouessart, Schlosser, Osborn, and others. This is probably a sub-order of the Monotremata.

[9] "Etude sur le Neoplagiaulax de la Faune Éocène inférieure, etc." Bull. d. l. Soc Géol. de France, Feb. 12, 1883, p. 259. Pl. VI., Fig. 17.

A premolar (Pl. VII., Figs. 13–16) is rightly described as an upper premolar, and correctly associated with this genus (compare Fig. 19, Lemoine [10]).

4. *Cimolodon nitidus* (Pl. II., Figs. 5–8). The type is described as an upper molar representing a new genus and family, the Cimolodontidæ.—Comparing it with the lower molars of Ptilodus [11] Cope, it is evident that the type is a first lower molar of one of the Plagiaulacidæ.

FIG. 1*b*.—Neoplagiaulax Lemoine. *c*, superior molar; *b*, superior premolar, 3-1.

5. *Nanomys minutus* (Pl. II., Figs. 9–12). The type is described as a last upper molar of the left side, and referred to the Cimolodontidæ.—A comparison with Ptilodus shows that it is a last lower molar of the right side, belonging to one of the Plagiaulacidæ.[12]

6. *Halodon sculptus* (Pl. III., Figs. 11–13). The type is a fourth lower premolar, rightly referred to one of the Plagiaulacidæ.

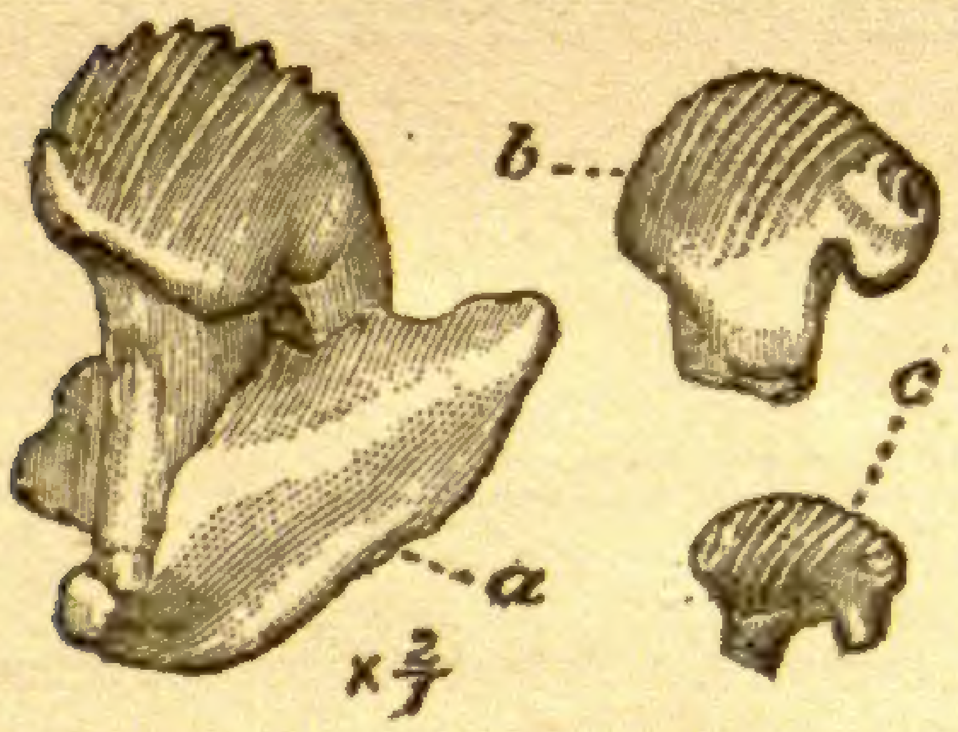


FIG. 2.—Halodon. Fourth inferior premolars of *a*, *H. sculptus*; *b*, *H. serratus*; *c*, *H. formosus*. After Marsh. All type specimens.

A superior incisor (Pl. III., Figs. 1–3) is referred to this species. It apparently belongs to a much larger form.

7. *Halodon serratus* (Pl. III., Figs. 14–17). The type is a fourth lower premolar, a smaller species rightly referred to one of the Plagiaulacidæ.

A superior incisor (Pl. III., Figs. 14–17) is referred to this species. It apparently belongs to a larger form.

It is a well-known fact that the upper molars of the Plagiaulacidæ have three rows of tubercles, while the lower molars have but two, and that the cusps of the lower rows fit into the valleys of the upper teeth. This is beautifully demonstrated in the author's own figures as here reproduced and rearranged in Figure 3: *a* is the type of *Cimolomys gracilis*, which fits upon *c*, the type of *Cimolodon nitidus*; while *b*, the type of *Nanomys minutus*,

[10] Op. cit., Pl. VI., Fig. 19*e*.

[11] This type (*C. nitidus*) has four internal and seven external tubercles; while *Ptilodus troversartianus* has four internal and six external tubercles.

[12] "The Tertiary Marsupialia." Cope, AM. NAT., July, 1884, p. 694.

would probably be found to coincide similarly with the type of *Cimolomys bellus*, unfortunately not figured by the author. This gives us the characters of the molars of what was possibly a new genus (Cimolomys) of the Plagiaulacidæ, intermediate between Plagiaulax with three well-developed premolars, and Ptilodus with one large and one extremely small premolar. This genus cannot at present be defined, because, so far as we can compare the molars and premolars, they closely resemble in size and development the corresponding teeth of Ptilodus. The premolars of this genus are, of course, found in the species of Halodon. The premolar referred to *H. serratus* agrees best in size with the molars of *C. gracilis*.

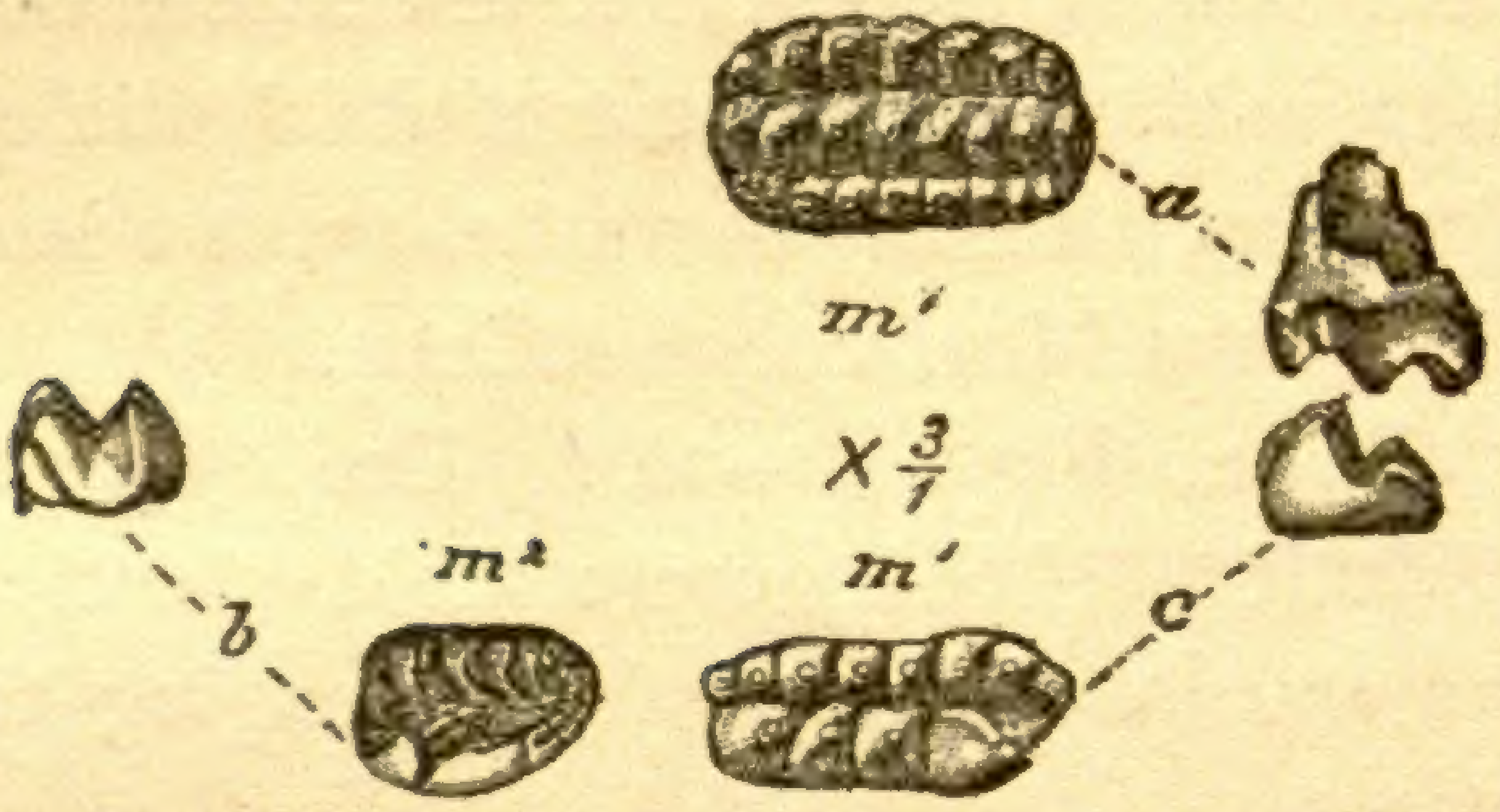


FIG. 3.—Upper and lower molars of Cimolomys. (Cimolomidæ), *a*, *Cimolomys gracilis*. (Cimolodontidæ), *b*, *Cimolodon nitidus*; *c*, *Nanomys minutus*. After Marsh. All type specimens.

The accompanying restoration of the upper and lower jaws of *Cimolomys gracilis* shows the various relationships of this animal as given in the above diagnoses by the author:

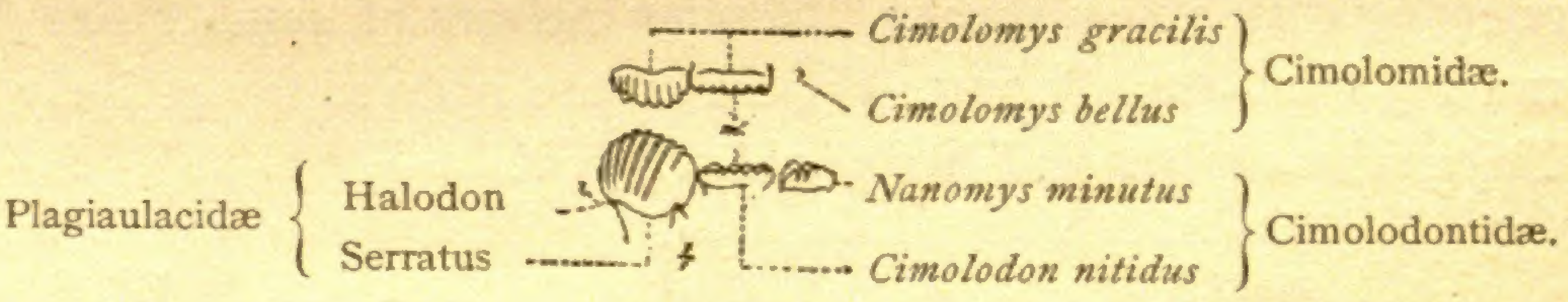


FIG. 4.—Upper and lower molars and premolars of ? Cimolomys, in position.

These relationships will probably be increased, rather than diminished, by future discoveries.[13] As it is, an upper and lower jaw referred to three families, five genera, and five species, is without precedent in paleontological literature.

8. *Dipriodon robustus* (Pl. II., Figs. 13–15). The type is probably correctly described as a last upper molar of the left side; it is referred to a new family, the Dipriodontidæ.

[13] See *Allacodon lentus*, which belongs either to this genus or to Meniscoëssus.

9. *Dipriodon lunatus* (Pl. II., Figs. 16–18). The type is rightly described as a first or second upper molar.—Keeping in mind the larger size and greater complexity of the more anterior molars, there is no ground for referring it to a new species.

10. *Tripriodon cœlatus* (Pl. II., Figs. 19–21). The type is described as a first upper molar, and is referred to a new family, the Tripriodontidae.—It resembles in the arrangement of its denticles the lower molars of Stereognathus, and, as shown below, is a last lower molar belonging to the genus Meniscoëssus Cope.

11. *Selenacodon fragilis* (Pl. II., Figs. 22–24). The type is described as an upper molar distinguished by crescentoid tubercles from the foregoing.—It is an anterior lower molar belonging to the genus Meniscoëssus Cope.

12. *Selenacodon brevis* (Pl. VII., Figs. 9–12). The type is described as an upper tooth, apparently from the left side.—As the accompanying figures show, it agrees in every detail, except the degree of wear, with the type of *Meniscoëssus conquistus* Cope; it is a lower molar, probably the last.

The lower incisor (Pl. VIII., Figs. 1–3) is probably correctly referred.

13. *Tripriodon caperatus* (Pl. III., Figs. 18–20). The type is correctly described as a lower incisor.—No ground is assigned for referring it to a new species. Similar incisors of smaller size (Pl. III., Figs. 21–22; Pl. VIII., Figs. 1–3) are referred respectively to *Tripriodon cœlatus* and *Selenacodon brevis*.

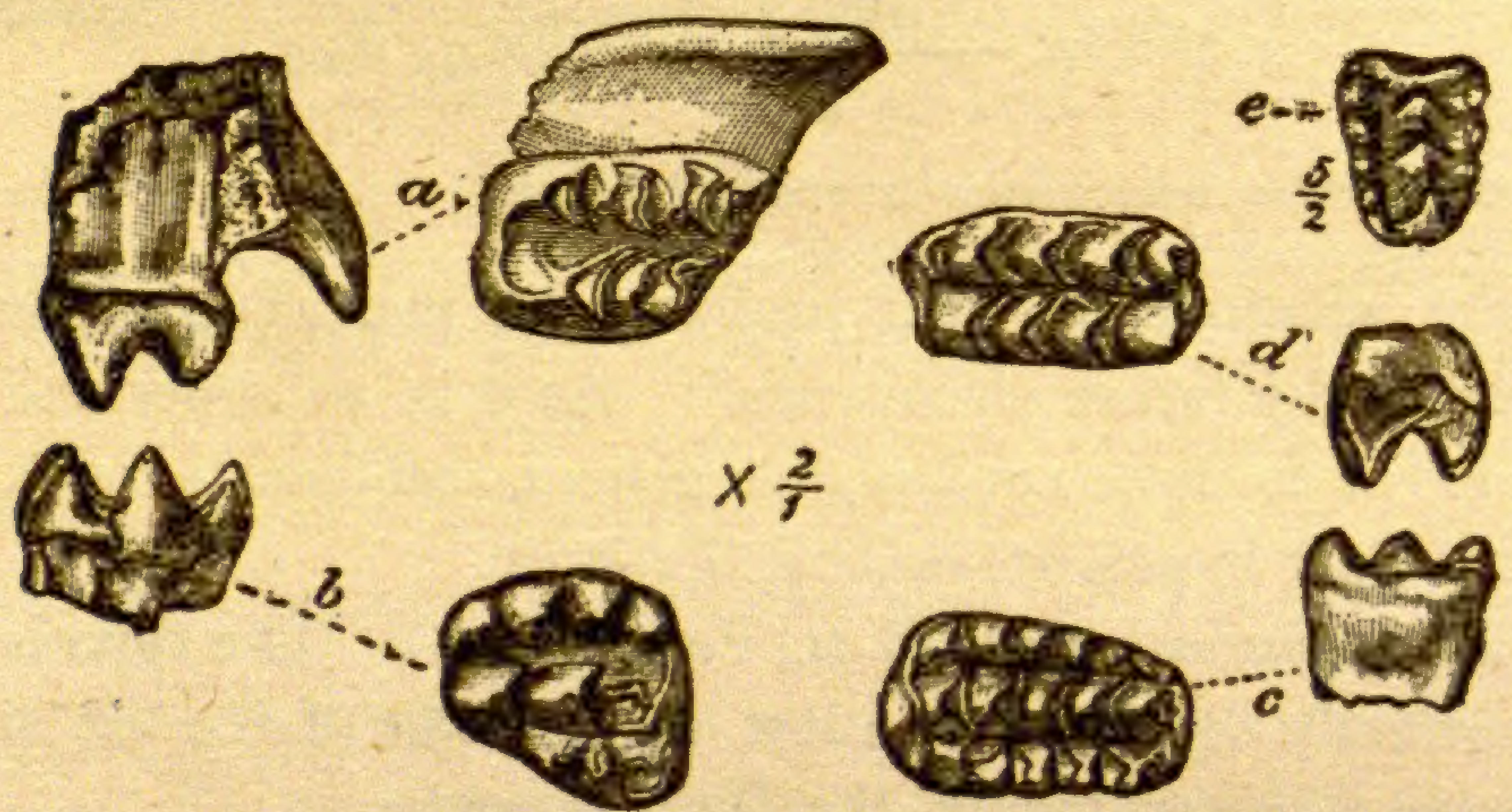


FIG. 5.—Upper and lower molars of Meniscoëssus. (Dipriodontidæ), *a*, *Dipriodon robustus*, crown view and end view; *d*, *D. lunatus*, crown view and end view. (Tripriodontidæ), *b*, *Tripriodon cœlatus*, crown view and end view; *c*, *Selenacodon fragilis*, crown view and end view; *e*, *S. brevis*. After Marsh. All type specimens, excepting *c*.

This collection of molars demonstrates that Meniscoëssus, like Stereognathus, belongs to a family in which the tubercles are crescentoid and arranged in two rows in the upper molars and three rows in the lower molars. This is admirably shown in the author's own figures as rearranged in Figure 5. *a*, the type of *Dipriodon robustus*, is seen to fit upon *b*, the type of *Tripriodon cœlatus*; *d* and *c* belong to old individuals, but the worn cusps and valleys coincide; they are respectively the author's types of *Dipriodon lunatus* and a molar referred to *Selenacodon fragilis*, as it agrees exactly with the type except in point of wear.

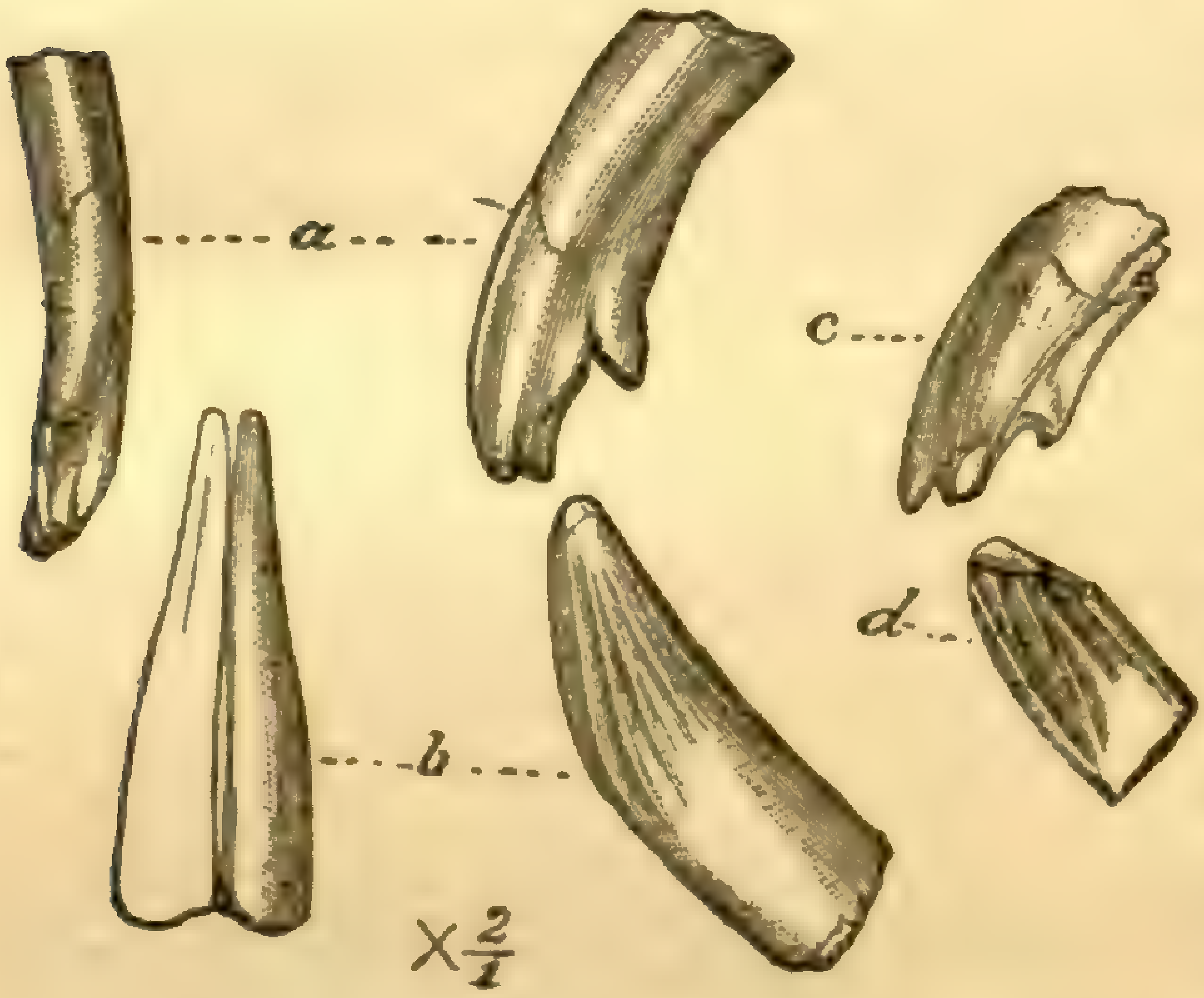


FIG. 6.— *a*, upper incisor of *Halodon sculptus*; *b*, lower incisor of *Tripriodon caperatus*, type; *c*, upper incisor of *Halodon serratus*; *d*, lower incisor of *Selenacodon brevis*. After Marsh.

The lower incisor, type of *Tripriodon caperatus*, corresponds in size with these molars; the two smaller incisors, referred to *T. cœlatus* and *Selenacodon brevis*, have the same shape and grooved sides. (1) When these incisors are placed side by side, as in Fig. 5, with the upper incisors referred by the author to *Halodon sculptus* and *Halodon serratus*, we observe that the longitudinal and transverse diameters of the crowns and fangs coincide exactly in measurement, rendering it highly probable that they belong to the same species. (2) The question is, Do these teeth belong to Halodon or Meniscoëssus? We observe that the lower incisor associated with *Halodon formosus* (Pl. VIII., Figs. 32–35) has the enamel confined to a band, as in Ptilodus and Neoplagiaulax. It is smooth. It is, therefore, probable that all these striated, completely enameled incisors belong to Meniscoëssus. (3) When, moreover, it is seen that these

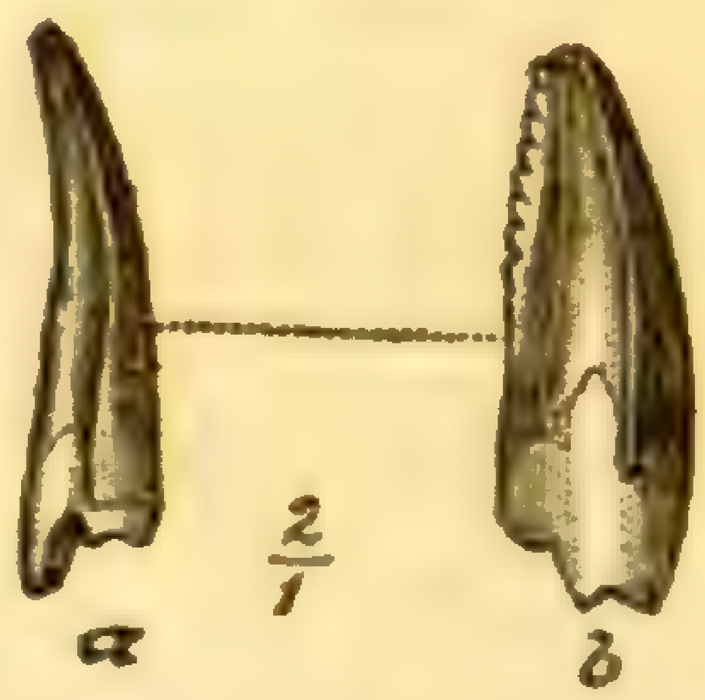


FIG. 7.—Tooth determined as an "upper incisor" of *Dipriodon robustus*.

incisors are far too large to be associated with the premolars of *H. sculptus* and *H. serratus*, we have further grounds for associating them with Meniscoëssus, with which they agree in size. The tooth (Fig. 7) assigned by the author as the upper incisor of *Dipriodon robustus* apparently belongs to a reptile. It is unlike any incisor hitherto found with the Multituberculata.

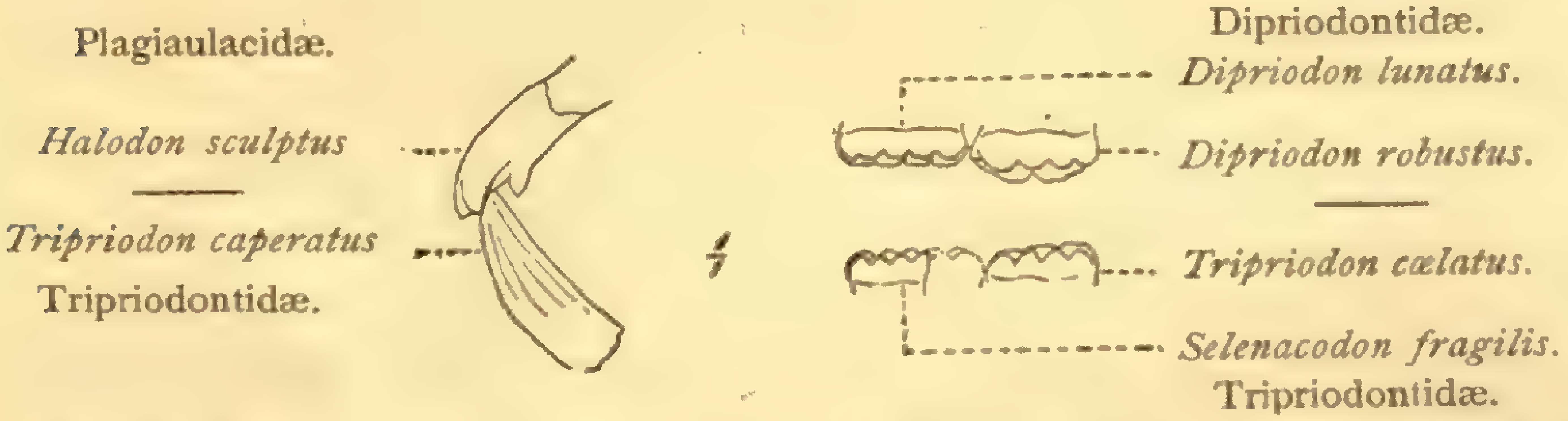


FIG. 8.—Upper and lower molars of Meniscoëssus in position. (Association of incisors with molars conjectural.)

The accompanying restoration is based upon the foregoing considerations, and show that, according to the author, the relationships of Meniscoëssus are as varied as those of its contemporary, Cimolomys, including three families, four genera, and seven species.

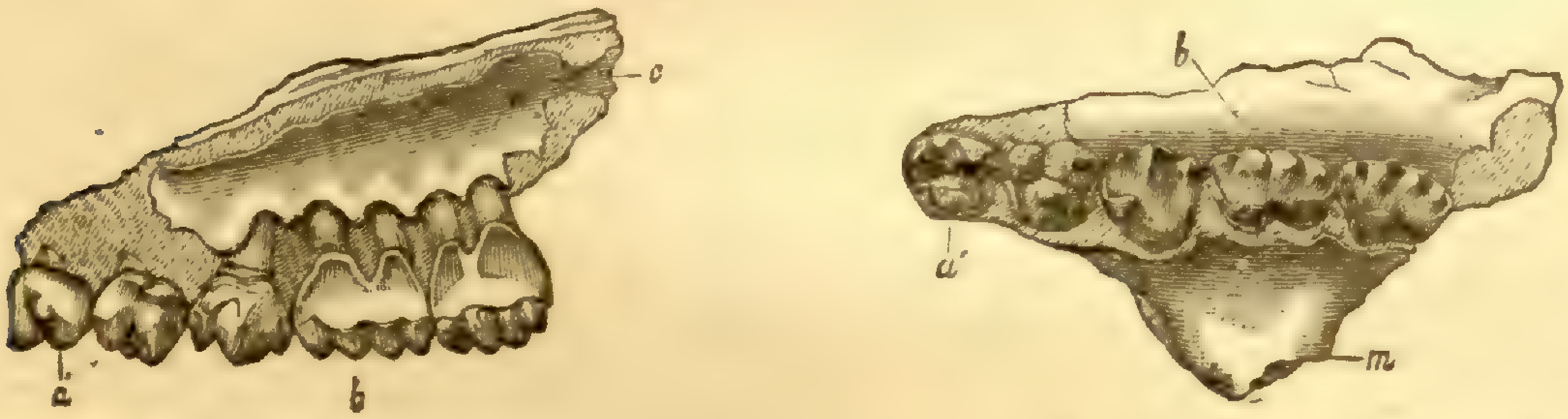


FIG. 8*a*.—*Ctenacodon potens* Marsh, 4–1. *a*, inner view of right upper jaw; *b*, ventral view of same; *a–b*, first to fourth premolar, as interpreted by Marsh. After Marsh.

14. *Allacodon lentus* and *A. pumilus* (Pl. VIII., Figs. 22–26–31). The types are described as upper molars of a genus related to Allodon and Bolodon, and referred to the Allodontidæ.—It is a universal characteristic of the molars of the Multituberculata that, as the grooves are adapted for fore and aft wear, the tubercles are arranged on the sides. In the type of Allacodon a tubercle stops the valley; these types are unadapted to fore and aft wear,—they are,

FIG. 9.—*Allacodon lentus*. After Marsh. Types.

therefore, premolars, and probably belong either with Meniscoës-sus or Cimolomys, or possibly with some other genus the molars of which are not represented in this collection. Upper premolars of this type are seen in Chirox Cope; Bolodon Owen and Ctenacodon Marsh.

15. *Oracodon anceps* (Pl. VIII., Figs. 13–16). This type is rightly described as a premolar, but no grounds are given for considering that it belongs to a distinct genus and species.

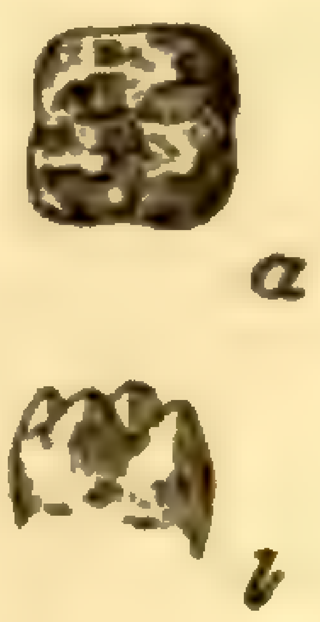


FIG. 8*b*.—*Tritylodon Fraasii.* Supposed premolar.

16. *Camptomus amplus* (Pl. V., Figs. 1, 2). The type is a scapula with which are associated other bones, calcaneum, astragalus, interclavicle. No grounds are assigned for separating these remains from genera founded upon the teeth.—The astragalus bears the same proportion to the molar teeth of Meniscoëssus that we observe in Polymastodon; it is also apparently perforated. The affinities of these forms to the Monotremata have been observed by Cope; the coraco-scapular facet, therefore, strengthens the supposition that some of these bones at least belong to Meniscoëssus. In any case, they cannot be considered as good types.

This completes the Multituberculate forms.

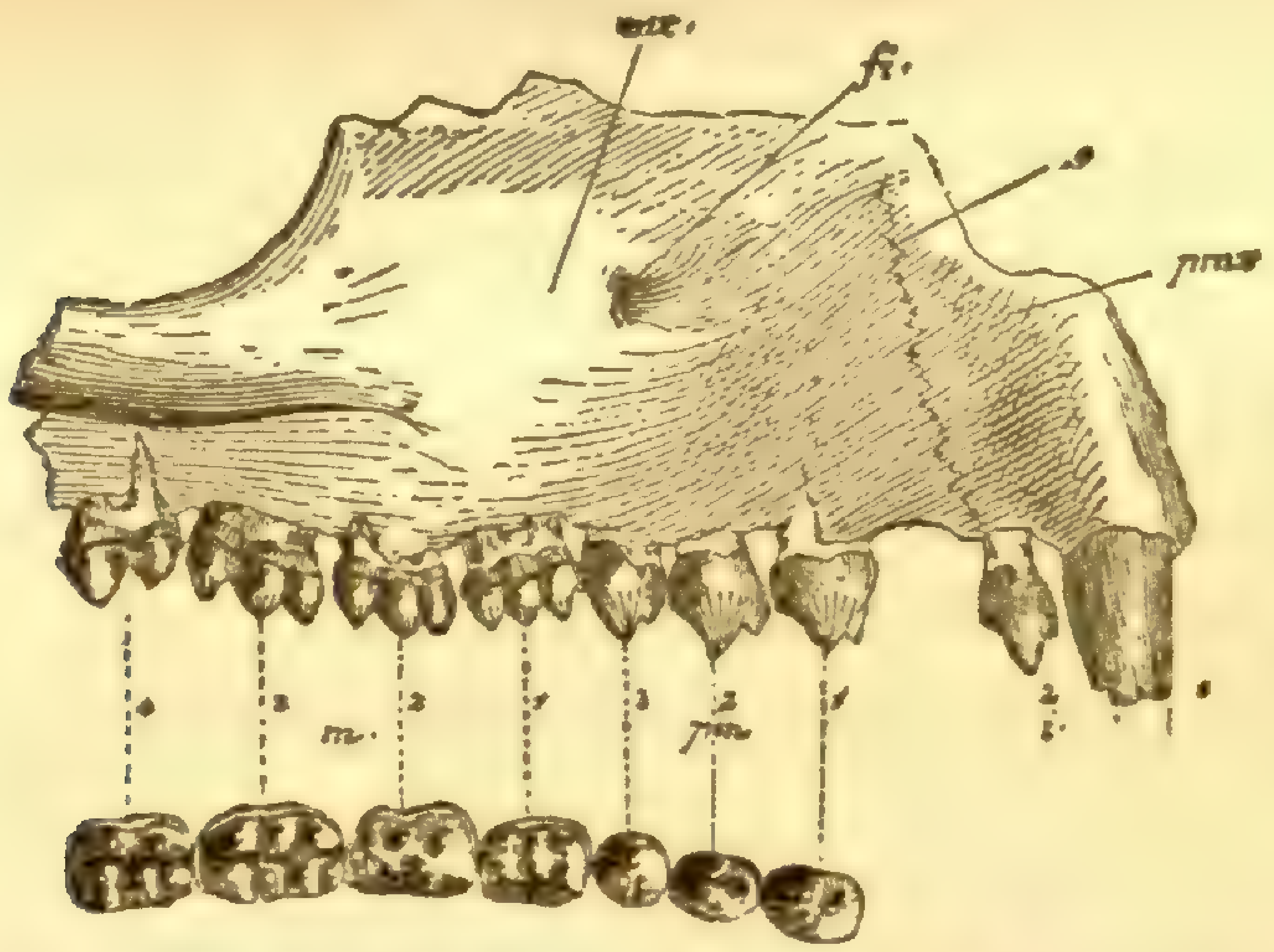
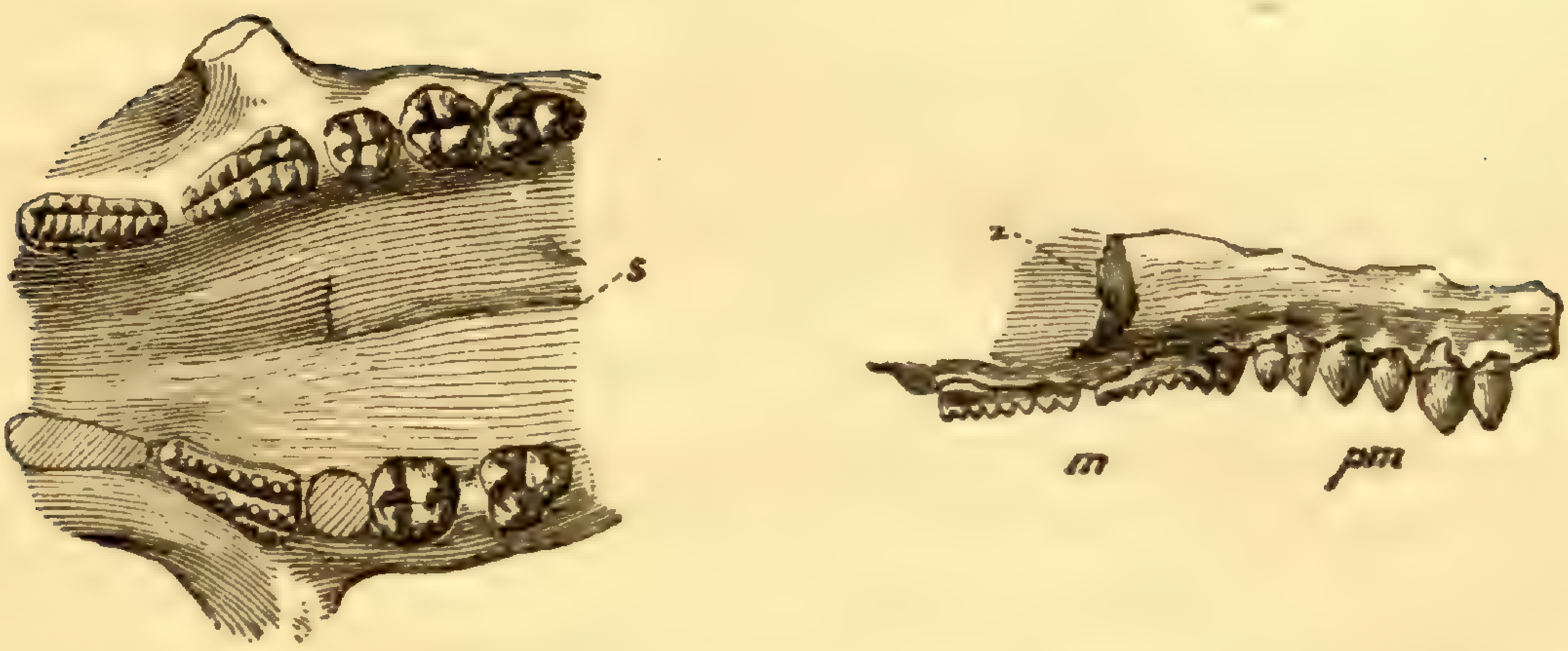


FIG. 10.—*Bolodon crassidens* Owen, 4–1. Outer surface of right maxilla and ventral view of premolars and molars.



a. b.

FIG. 11.—*Chirox plicatus* Cope, 3–2. *a*, palate with three premolars and two molars, *in situ*; *b*, external view, right side.

B.—Trituberculate Forms.

17. *Dryolestes tenax* (no figure). The type is a lower jaw with a mylohyoid groove, in which the number and character of the teeth "cannot be determined." The author's reference is provisional.

18. *Didelphops* (*Didelphodon*) *vorax* (Pl. IV., Figs. 1–3). The type is an upper molar, distinguished from Didelphys by intermediate tubercles.—This character does not separate it from the large number of Trituberculates with similar molars; the genus is, therefore, undefined at present. The other species, *D. ferox* and *D. comptus*, are also undefinable.

19. *Pediomys elegans* (Pl. IV., Figs. 23–25). The type is an upper molar.—It is not distinguished generically from Didelphodon.

20. *Cimolestes curtus* and *incisus* (Pl. IV., Figs. 8–18). The types are lower molars.—Like Didelphodon, these forms cannot be defined; they are tuberculo-sectorial.

It is evident that we have here remains of two distinct and probably new genera, which may be accepted without definition.

C.—Incertæ sedis.

21. *Stagodon nitor* (Pl. VII., Figs. 22–25). The types are a few teeth with single fangs, referred to a new family, the Stagodontidæ.

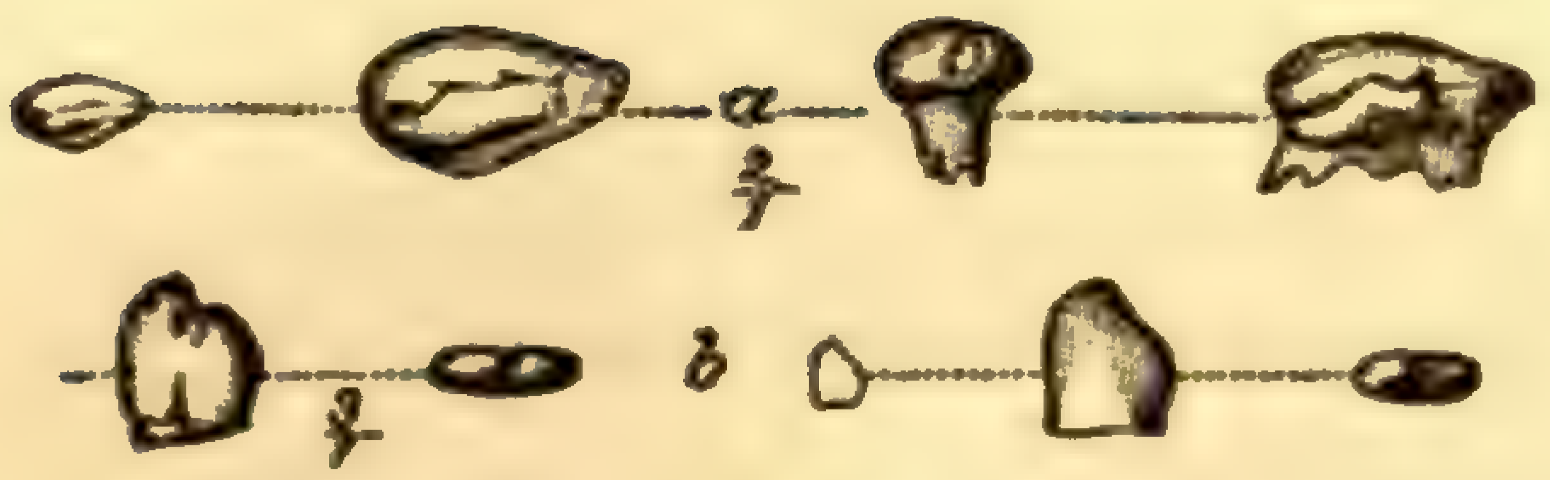


FIG. 12.—(Stagodontidæ), *a*, *Stagodon nitor*; *b*, *Platacodon nanus*. After Marsh. Types.

—They do not resemble the teeth of any known mammal, although described as having two fangs, which are, however, not shown in the figures. The premolar associated is distinctly mammalian.

22. *Platacodon nanus* (Pl. VIII., Figs. 4–12). The types are compared to the molars of Chrysochloris.—They do not bear the most remote resemblance to the molars of Chrysochloris or any other known mammal. Prof. Dames considers that they belong to the Cyprinoid fishes.[14]

The above types do not resemble in the most remote degree the molars in either the Multituberculate or Trituberculate series, —the only two mammalian series hitherto represented in all the discoveries of Mesozoic or Eocene times. Nor have they, as figured, any of the characteristics which we expect to find in mammalian teeth.[15] They should, therefore, be considered either reptilian or icthyopsidan; we cannot agree with the author that they are "evidently mammalian."

The above analysis may be summarized under the following heads. We find that the author has: 1. Separated parts which evidently belong together; *vide*, various teeth of Cimolomys and Meniscoëssus; 2. United parts which apparently or certainly belong together; *vide*, the large upper incisors with Cimolomys, the reptilian or fish molar of Stagodon with a mammalian premolar, the reptilian tooth as an upper incisor of Dipriodon; 3. Associated or identified reptilian or icthyopsidan teeth as mammàlian; *vide*, Platacodon, Stagodon, and incisor of *D. robustus*.

The large Cretaceous fauna described by the writer is therefore seen to be principally composed of synonyms. We must eliminate:

[14] This author reaches very similar conclusions in regard to this paper. *Neues Jahr. f. Min. u. Geol.*, 1890, pp. 141–143.

[15] See H. G. Seeley. "On the Nature and Limits of Reptilian Character in Mammalian Teeth." Proc. Roy. Soc., April 4th, 1888, p. 129.

1. The terms preoccupied by other authors.

2. The terms founded upon different parts of the same animal, and thus largely preoccupied by the author himself.

3. The terms founded upon imperfect or indefinite types.

4. The terms founded upon reptilian or icthyopsidan teeth.

A. ALLOTHERIA.	=	A. MULTITUBERCULATA Cope. (In part.)
1. CIMOLOMIDÆ. *Cimolomys gracilis* " *bellus* " *digona* 2. CIMOLODONTIDÆ. *Cimolodon nitidus* *Nanomys minutus* 3. PLAGIAULACIDÆ. *Halodon sculptus* " *serratus* " *formosus*	=	1. PLAGIAULACIDÆ Gill. CIMOLOMYS Marsh; two or three species.
4. DIPRIODONTIDÆ. *Dipriodon robustus* " *lunatus* 5. TRIPRIODONTIDÆ. *Tripriodon cœlatus* " *caperatus* *Selenacodon fragilis* " *brevis*	=	? 2. STEREOGNATHIDÆ, fam. nov. MENISCOESSUS Cope; two species.
6. ALLODONTIDÆ. *Allacodon lentus* " *pumilus*		Probably preoccupied.
? *Camptomus amplus* ? *Oracodon anceps*		Indefinite types or preoccupied.
? B. PANTOTHERIA. ? 7. DRYOLESTIDÆ. ? *Dryolestes tenax*		Indefinite type.
C. MARSUPIALIA. *Didelphops vorax* " *ferox* " *comptus* *Cimolestes incisus* " *curtus* D. INSECTIVORA. *Pediomys elegans*		B. Order indeterminate = Creodonta, Insectivora or Marsupialia. DIDELPHOPS Marsh; two spec's. CIMOLESTES Marsh; ? species. Not defined.

E. INCERTÆ SEDIS. 8. STAGODONTIDÆ. *Stagodon nitor* *Platacodon nanus*	Founded upon reptilian or icthyopsidan teeth.

This reduces the Cretaceous mammals described in these two papers to one well-determined order or suborder, two well-determined families, and four or five genera, one of which can now be well defined (Meniscoëssus), while the remainder are probably distinct genera, which we may be able to define by the acquisition of more material (Cimolomys, Didelphops, and Cimolestes). There is no question that the majority of the remaining generic names are synonyms, although it is quite possible that some of the types described, such as Oracodon and Pediomys, may be found to represent distinct or new genera.

It may be said that this analysis has almost eliminated the work of the author. This unfortunately is what is necessary if we would render this contribution of any permanent value in paleontology. We are, then, left with a series of teeth which represent rare skill on the part of the collector, and are figured with remarkable accuracy by the draughtsman. A few points of interest upon the collection as a whole may be mentioned :

The Multituberculata. The preponderance of teeth belonging to members of this order would appear to indicate that it flourished during this period. Cimolomys represents a connecting form between Plagiaulax, Upper Jurassic, with three premolars, and Ptilodus of the lowest Eocene with two. The smallest species, *C. formosus*, apparently has as many grooves upon the fourth premolar as we observe in Ptilodus, and the first lower molar has even more tubercles than we find in the corresponding tooth of the Lower Eocene genus. These grooves and tubercles mark the stages of development, and it would appear that Cimolomys is not far removed from Ptilodus ; this relation can only be determined by the discovery of additional teeth ; we may find that Cimolomys has a large third premolar.

Another interesting fact is that Meniscoëssus does not belong with the Plagiaulacidæ, as has been generally supposed hitherto,[16]

[16] Cope, Osborn, Lydekker.

but should apparently be placed with Stereognathus (with which its resemblance in molar structure has always been recognized) in a distinct family, the Stereognathidæ, distinguished by the presence of two rows of tubercles in the upper molars and three in the lower, of the crescentoid pattern. The more numerous tubercles in Meniscoëssus would accord well with its more recent character.

There are thus apparently only two families of the Multituberculates represented here,—unless, as the author has suggested, Allacodon belongs to the Bolodontidæ. We have yet to find the successors of the Tritylodontidæ and predecessors of Polymastodon and Chirox of the Lower Eocene.[17]

As for the Trituberculate forms, there are evidently two distinct genera, which probably belong to different families. The types of Didelphops and Cimolestes closely resemble molars found respectively among the Mesodonta, the Creodonta, Insectivora, and Marsupialia. Their systematic position is, therefore, very uncertain from this evidence. They mark, however, a very great advance upon the Jurassic forms in tooth evolution. We find in Didelphops the earliest low-crowned tritubercular molar which has been obtained, with one or two intermediate tubercles, while the lower molar is the earliest quinquetubercular tooth known. The Cimolestes molar is tuberculo-sectorial, and presents a marked advance upon Jurassic tooth types, but has, nevertheless, a broad talon, with both the entoconid and hypoconid developed, whereas all Jurassic forms present the hypoconid only.

The bones of the appendicular skeleton present a number of very interesting points, some of which the author mentions. These are: the coracoid facet upon the scapula; the interclavicular. We note also the flat astragalus, without a neck, apparently perforated by an astragalar foramen,[18] and with a broad cuboidal facet as well the navicular facet. The calcaneum has a narrow sustentaculum.

[17] The nearest resemblance to Polymastodon is that observed in the striated lower incisors here copied in Figure 5. This genus will undoubtedly be found represented in these beds.

[18] This observation rests solely upon the figure. All astragali of the Lower Eocene display this foramen.

We look forward with great interest to Part III. of this series of papers, as this collection is a most valuable and interesting one; and the above review is not intended in any way to depreciate the importance of an increased knowledge of the Cretaceous Mammalia.

NOTES ON MESOZOIC MAMMALIA.[1]

BY O. C. MARSH.

I HAVE recently received from Prof. H. F. Osborn a pamphlet entitled "A Review of the Cretaceous Mammalia," which is intended as a criticism of two of my papers, and is a characteristic addition to his previous publications on Mesozoic mammals. It is difficult to take this review seriously, as it contains no new facts, and is mainly an application of the author's theories, which may, in part, prove to be true, but at present are without substantial basis. To attempt to refute all the assumptions he makes would involve a long discussion of known Mesozoic mammals, and take time from more important work. A brief notice of a few points, therefore, must suffice for the present.

Every one familiar with Mesozoic mammals knows that the author of this review has never collected any, has no specimens of the kind, and has only seen a part of those belonging to others, who have shown them to him as a matter of courtesy, in some cases even when an investigation was intended or in progress. Of more than a thousand specimens of Cretaceous mammals on which my investigations are based, he has not seen a single one, and no others are known except a few fragments. Of several hundred specimens of Jurassic mammals which I have secured in the west, he has seen perhaps one-tenth; while of other Mesozoic mammals from this country, he cannot have seen in all more than a half dozen specimens.

[1] As presented to the Academy of Natural Sciences, Philadelphia, April 14th, 1891. Published, with some alterations, in the Proceedings of the Academy.

Prof. Osborn's other qualifications for discussing Cretaceous mammals do not seem especially conspicuous. Certainly his papers on other Mesozoic mammals do not show that high degree of accuracy which a critic should put into them. One or two examples will make this evident.

He began this work in 1886 with borrowing two specimens of Dromatherium Emmons, and making a new genus of one of them, on insufficient grounds. In a characteristic manner, he commenced by criticising Emmons's work, especially one figure, but this he subsequently retracted. His own figures of one of these fossils agree neither with each other nor with the specimen, as a recent comparison shows.

He next turned his attention to the Mesozoic mammals in the British Museum, beginning with the Triassic Tritylodon from South Africa described by Owen. Again Prof. Osborn did not agree with the original authority, but announced in print that a most important point had not been appreciated by Owen: namely, a large parietal foramen, which showed that "the primitive Mammalia, of this family at least, had a pineal eye of some functional size and value,"—a most interesting discovery, if true. A reference to the specimen itself proved that there was no foundation whatever for the announcement, and Prof. Osborn was compelled to retract it (*Science*, Vol. IX., p. 92 and p. 538, 1887).

The results of Prof. Osborn's further study of the Mesozoic mammals in the British Museum were not considered important by some of the best authorities there, and some of his observations they disproved, in my presence, by referring to the fossils themselves. His figures of these specimens, moreover, are not accurate, and in some cases are misleading, as a single example will show. In his Mesozoic Mammalia, Plate VII., he gives a new figure of the type of Phascolotherium, but a comparison with the original specimen shows that this fine figure is erroneous in at least four important points: namely, the first incisor; the crown of the last molar, which is wanting in the specimen; the position of the dental foramen; and the mylohyoid groove. His very objectionable method of regarding different isolated specimens as identical, and making a "composite" drawing of them, as repre-

senting a single type, led into other serious errors. This method, which belongs rather to metaphysics than to natural science, Prof. Osborn has again used in the present review, and with no better results.

This long review purports to discuss my first and second papers on Cretaceous mammals. The first thing that strikes the careful reader is the title he gives to these papers. My own title was a simple one, " Discovery of Cretaceous Mammalia," and it is only fair to expect, in an elaborate review, that the title, at least, will be correctly quoted. Instead of this, Prof. Osborn has added two other words, giving it a different meaning, but quoting it as mine: namely, "The Discovery of the Cretaceous Mammalia." He read this review in no less than three different cities, and published an abstract elsewhere, yet apparently had no time to read my title of four words carefully enough to quote it correctly. A small matter, perhaps, but proof positive of careless work.

The next point to be noticed is that my order Allotheria is rejected as not having been defined, and a later term, Multituberculata, is adopted because it has been defined. This direct statement of Prof. Osborn is incorrect, as my order was defined when proposed in 1880 (*Am. Jour. Sci.*, Vol. XX., p. 239). The cumbersome term Multituberculata was not defined when proposed by Cope in 1884, but Prof. Osborn kindly attempted this in 1888. His definition, unfortunately, does not include some characteristic forms of the group, but takes in accurately the genus Mastodon, although this great Proboscidian can hardly be considered a Marsupial.

By way of instruction, Prof. Osborn is good enough to indicate what he terms " the main characters of the dentition of the Mesozoic mammals in general, and some characters which enable us to distinguish between the teeth of mammals and those of reptiles and fishes." This is a most promising statement, but loses some of its force when we find that it has not saved him from precisely these mistakes, either in his previous papers or in the present review, as I show later.

He is scarcely more fortunate in his announcement of what he regards as the well-known characters of the teeth of one group,

the Allotheria. I have probably seen all the Mesozoic mammals examined by Prof. Osborn in Europe, and likewise quite a number of others, including the type of Stereognathus. He is certainly wrong in several of his main conclusions, and in others there are many facts against him.

A more correct restatement of some of the characters of this group would be as follows:

1. No true Plagiaulacidæ are known with three rows of tubercles on the upper molars.

2. No Allotheria are known with certainty to have three rows of tubercles on the lower molars.

A careful study, moreover, of the known specimens of the true Plagiaulacidæ would have shown him the strong probability, at least, that the genus Bolodon, which he makes the type of a distinct family, is based on the upper jaws of Plagiaulax; also, the probability, as I have before suggested, that the type of Stereognathus, of which he makes another of his numerous families, is an upper jaw, although described as a lower one.

Bearing in mind these points, Prof. Osborn's main criticisms are seen to be without foundation, and the errors largely his own. By substituting theory for the actual study of well-preserved specimens, he has unwittingly placed on record the fact that he cannot tell upper from lower teeth in Mesozoic mammals, nor the teeth of reptiles and fishes from those of mammals.

There is now conclusive evidence that the Cretaceous molar teeth with three-rows of crescents belong to the upper series, as I described them. Prof. Osborn's reference of these to the lower jaw is based merely on theory, with only conjecture to support it. The same fundamental error runs through most of his reviews, and measures the value of his criticism.

Another unfortunate error of Prof. Osborn was mistaking the tooth of a reptile for the premolar of a mammal, and not only describing and figuring it as such, but making this a basis for using a generic name (Meniscoëssus), against well-known laws of nomenclature. This supposed premolar he figures and describes in his Mesozoic Mammalia (p. 218), and has elsewhere strongly defended its mammalian character. There is not a particle of

evidence of this, as every one familiar with similar specimens knows.

Notwithstanding this inexcusable mistake, Prof. Osborn ventures to assert in his review that a tooth, which I described and figured as a molar of a mammal, Stagodon, has but a single fang, does "not resemble the teeth of any known mammal," and that the genus was "founded upon reptilian or ichthyopsidian teeth." I distinctly stated that this tooth has two fangs, and the bases of these were indicated in one of my figures. Moreover, several well-preserved specimens since obtained show two distinct roots, and other features which prove these teeth mammalian beyond doubt.

In his Mesozoic Mammalia (p. 221) Prof. Osborn describes and figures as a premolar a specimen which is now almost certainly known to pertain to a fish, and not to a mammal. I have a very similar specimen from the same locality, which is pronounced the same species by those who have examined both. This I purchased many years ago of a well-known collector in Stuttgart, who called it a mammal tooth. When investigating Mesozoic mammals later, I examined this specimen with care, and found it to be made up of two portions of fish teeth (Hybodus) neatly cemented together, making four cones on a quadrate base, as in the fossil Prof. Osborn so carefully described. A friend who saw my specimen here has since sent me from Europe drawings of a third supposed mammal tooth from the same locality (Diegerloch), which he considers the same as mine. The drawings are characteristic, and indicate another specimen of apparently the same sort. Others are probably in existence, as the demand for Mesozoic mammals is great, and the supply has hitherto been limited.

One or two points more should be mentioned about Prof. Osborn's work on Mesozoic mammals: namely, his habit of replacing, on insufficient grounds, scientific names, especially those of families and genera, by other names of his own; also, using the figures of other authors without the usual credit. As an example of the latter, I may cite this use of no less than five of my figures of Jurassic mammals, in his memoir on Mesozoic Mammalia.

Prof. Osborn in his review alludes to "the extremely complex and confusing dentition" of some Mesozoic mammals, and of the truth of this statement his own papers afford many illustrations besides those here mentioned. What this perplexing subject really needs, however, is more facts and less theories. Believing this, I have endeavored to secure new facts by long and laborious explorations, hoping in this way to clear up some of the confusion which so puzzles fireside naturalists. The 1,500 specimens Mesozoic mammals I have thus secured, fragmentary though most of them are, will, I trust, prove of some service in this work, although their full investigation has been delayed by other duties.

No one who has earnest work to do can afford to spend time in the ungracious task of pointing out errors in the work of others. For this reason, I have hitherto said nothing about the mistakes in Prof. Osborn's papers on Mesozoic mammals, intending to wait until my own memoir on the subject, for which I have collected so much material, should make it my duty to review the whole subject. The injustice of his criticism on my preliminary work while in progress made a brief reply necessary. The full discussion, I must still reserve for my memoir.

New Haven, Conn., April 10th, 1891.

THE COMING MAN.

BY S. V. CLEVENGER.

SANCHO PANZA remarked that men were as God made them, and sometimes a great deal worse. But it is becoming known that the world is really improving; that a line touching the dark ages and passing through our present imperfect civilization may be produced indefinitely, in imagination, toward better things. So Sancho's horizon was cramped, and we may now believe that man in general is better than he was born.

Of course "perfection" in anything is unattainable, and discussion of the "perfect man" could only be carried to any sort of a conclusion by, first of all, recognizing that there cannot be such a creation, for the very conception involves contradictions. Herbert Spencer has ably gone over this and kindred subjects in showing that everything is relative, and that no matter what advances may be made, others are still possible. Equilibrium means death, a cessation of inter- and counter-action. "Perfection" is inconceivable, and the ignorant, who imagine they can conceive it, may be convinced that their ideal was a frightful hobgoblin after all.

Picture to yourself what the African, the American Indian, or the primitive people of any country, would regard as the perfect man, and compare their wild and, in the main, hideous conceptions with those of "civilized" men,—particularly that portion to whom thought is an effort. But as the science of comparative mythology plainly shows that deification is this same process; that gods were always big men; anthropomorphism, from which no one can completely free himself, runs rampant through our ideas of any sort of superiority, whether of this world or another, The Joves, Wodins, Thors, Brahmas were muscular and sometimes noisy, and some early races allotted many legs and arms or other parts to their gods; or, as in an Egyptian instance, conferred extraordinary length of arms, as symbolizing great power.

And in this *powerfulness* we have the general underlying agreement as to, at least, what is accomplished by "perfection."

This apparently indirect manner of approach to our subject enables us to save time by clearing up in our minds what we mean, and do not mean, when we speak of the perfect man, or his approximation, *the better man.* And still we are driven to narrower ground by recollecting that John L. Sullivan might have an opinion on this topic differing somewhat from that of Oliver Wendell Holmes and other essayists.

We are asked: "What qualities are most essential for the perfecting of a human being? What are the cardinal points to be insisted upon for the all-round development of the coming man?"

The modern scientific method of finding an answer would compel us to take another ramble over creation, for man is part of the universe, and cannot be fairly considered apart therefrom, though we may avoid unnecessary discursiveness in the endeavor.

Looking at the worst phase first, in all ages man has been a sorry sort of brute, with animal propensities, desires, passions; and, as Buckle has fully shown, his civilization has been a growth from feuds, follies, conquests, individual and tribal selfishness and rapacity; but with increase of intelligence a respect for the rights of others came about, because man recognized that he best conserved his selfish interests by mutual regard. Self-protection was assured by family protection, and both these by tribal protection, and it is dawning upon the world that national barriers must eventually give way to the universality of interests; nor is the heterogeneity of the "brotherhood of man," with diversity of aims, ideas, capabilities, and needs, any greater, comparatively, to-day, between races, than it was ages ago between many individuals of the same tribe.

Altruism is the highest egoism, and is developed from it. In plain words, as Darwin expressed it, club law instituted morality in savage tribes. This club law, and the fear of it, led to an habitual regard for the method of avoiding its enforcement, and it became folly to be other than virtuous under such circumstances.

Knight errantry, the duello, and finally, in these days, suits at

law, with occasional relapses into the older methods of adjustment, afforded object lessons in expediency which sages and patriarchs dwelt upon to the inexperienced.

The history of the world includes the evolution from lower to higher expediency ideals. Disregard for the rights of others was a means by which our savage ancestors sought to prolong life and secure enjoyment. With less of this brutality, but nevertheless with plenty of suffering abounding through his thoughtlessness and his inability to curb his passions, the barbarian is an improvement upon the savage in this matter of expediency ideals. His love of ornamentation, luxuriance, and similar childish traits cause his actions to be merely an exaggeration of what we find to-day in civilized society. "Civilized" nations are but barbarians masquerading in the apparel afforded them by a development of the arts and sciences beyond their deserts. The earrings, the bustles, the tight lacing, the artificialities generally, the worship of wealth, the indifference as to how one may have acquired money, the abandonment to pleasure procuring, sightseeing in and avoidance of scenes of suffering and squalor, the social vanities and dissipations, prove that the masses, rich and poor alike, divested of the tinsel afforded them by the fair devotees of science and art, might as readily be Turks or Hottentots.

Vulgar expediency ideals pervade our popular novels. The getting of wealth, the capturing of beauty, the utter want of a worthy aim in life prevail, and the success of authors who pander to this taste is a measure of what the purchasers of these books appreciate.

The right does not change, but our ideas of right do. Hero worship is dying out, and principles, not men, receive more deference. The race has had to make this advance through bitter experience, constant disappointments, disillusions, the shattering of idols, the growth of knowledge. Religion, with its hopes and fears, its system of rewards and punishments, notwithstanding these were "other worldly," became stimuli to good and deterrants from evil. The bare fact that some would act consistently with belief that there was a life after death, where he would suffer pain or pleasure according to what he had done in

this world, shows that the believer was guided by expediency, but truly of a higher kind. Surely the conventional ideas of right and wrong, even in this day, make a grand mess. The biases are innumerable that are created by rank, caste, prejudice, relative degrees of ignorance and intelligence, training, education, and nationality. A single instance can be cited: the term "morganatic," which is a wink at the license of royalty. "The king can do no wrong." Princes may be debauchees, drunkards, vicious, but they are defended, and their most public outrages are denied or condoned. Even dictionaries smile complacently at the villiany of nobles by giving a definition that does not include all that is known to be the meaning of the word morganatic.

However much we may assert to the contrary, and even though upon reflection we acknowledge to ourselves that wealth and good looks should not be measures of respectability, the childish trait is universally prevalent, even among civilized adults, that the good looking man, the well-dressed man, the wealthy man, is alone the good man. Poverty is regarded as evidence of punishment for wickedness. The every act of the bulk of mankind proclaim this to be a deep-rooted belief.

But surely there is a conscience, private and public, that works for final good. Undoubtedly. But we can understand that conscience, and its peculiarities and well-known inconsistencies, if we can bring ourselves to calmly inspect its origin in the law that *the altered or acquired habits of one set of ancestors may greatly affect the conduct of their descendants.* For instance, A is a murderer and freebooter, living many centuries ago, when to be otherwise was scarcely the rule. His surroundings and associations made him such. His child, B, at a later time and under better influences, is taught a disrelish for his parents' pastimes, but could easily relapse, as the inherited instincts were strong within him.

The good influence is kept up, however, and the grandchild, C, does not murder or plunder, because he has inherited a corrected disposition, which is intensified by the circumstances under which he lives. The great grandchild, D, by persistence of these conditions, would as surely be benefited by the inheritance for good

as he was likely to resemble his progenitors in feature or form. He has a ready-made conscience, for which he is not at all responsible, and deserves no credit. It might be so acute as to cause him to die of remorse, were he betrayed into wrongdoing.

Having reached this *negative* plane of mere respectability, D and his successors may develop some *positive* good trait, the habitual practice of which may become second nature. The feudal lord of A's time found happiness only in the desolation of others; F and G, his philosophical descendants, like Sir Titus Salt, grieve if they cannot find some means of doing lasting good to humanity, and yet from A to X, Y, and Z, expediency governs all of them.

One finds it most expedient to obey the promptings of his conscience, and derives comfort only from so doing. The keeping alive of that "celestial spark" may be to him more valuable than all the possessions of the world; while another, with none of this "spark" to speak of, or who may have had it developed in some other direction, kicks the beggar who annoys him, and laughs with pleasure when he recollects the event. The philanthropist feels a heart glow in remembering how he has relieved some one in distress or has contributed to some reform movement.

Different influences for good brought to bear upon successive generations are sure to appear in the last generation in a radical change of character from that of the remote ancestor, making it as impossible for X to do an evil deed deliberately as it was for A to do anything else. So you see that expediency, the doing of that from which we expect to draw the most comfort, is the controlling spirit of action in all.

The world's history shows that people became better only through intelligence; that this made it possible for them to adopt higher expediency planes; by regard for the rights of others each found his own rights best conserved. Nor did mankind, until the habit was instituted, do right from any other motive than that of mere convenience. The highest efflorescence of this natural law, beginning with the club, will be in the appearance of a highly developed altruism in a later age. Social maladies, poverty, and unhappiness will not be allowed to exist, upon the

principle, but recently discovered, that the presence of a degraded race devolves the degradation of neighboring races.

The structure of the brain itself shows that expediency regard is intellect; the nervous system plainly rules bodily parts. In higher and still higher grades of intelligence the connecting strands of the brain, the countless tangles of telegraph lines that inter-relate these parts, are more complex and numerous; and the main distinction between the idiot and one who is mentally sound is that the latter, by the integrity of his mental mechanism, is able to better adjust his inner to his outer relations. He is more in keeping with his surroundings. So goodness is a form of wisdom, after all. Habit and conscience make it possible for us to do right for right's sake, but habit and conscience are the product of your environment and what you have inherited. Conscience causes the right thing to be automatically performed. You do instinctively, and perforce, what before required a motive, just as the engineer can manage his machine in the dark and without thought, but when he was learning to do so his every sense must be alert. This view explains the inconsistencies of our nature; morality is but intellect, and no intellect is completely symmetrical. Ideas of propriety vary within wide limits. Disease may degrade mind in one way in one patient, and in other ways in other patients, depending upon the resistive strength of inherited traits, and what has been inherited.

And this brings us to a consideration of the old saw, "*mens sana*," etc., from the anthropological or physical point of view. A superficial consideration would suggest that mind and body must be developed symmetrically to accomplish the best results, but while this may hold good for mediocrity in both, which is nature's method of averaging things, we can readily see that athletes, gymnasts, pugilists unduly nourish and train their muscles at the expense of their brains, and that book-worms and thinkers generally incline to too much passivity physically. The world has reaped advantage from its diseased and bodily imperfect Gibbon, Tom Hood, Walter Scott, Sam Johnson, and Byron, though in different measures, and from imperfect temperaments such as Bacon, Coleridge, Dean Swift, De Quincy. But we should only

consider their defects as their misfortunes, and not the cause of their literary bents, for mental deformity has among potentates been the cause of untold suffering to nations. Neither physical nor mental perfection (if we can grant that such things existed) seem to have assured lasting integrity to either body or mind. The Spartans as a race do not appear to have been the fittest to survive, and during certain epochs in European history the man who dared to think at all could with difficulty keep his head on his shoulders.

But we must not lose sight of the fact that the world has profited more by the individual labors of men and women whose intellectual greatness was coupled with such extreme modesty that, while in quiet ways their power for good was incalculable, they never cared to take credit for it. "Full many a flower," etc., as Cowper has it.

As good machinery may, other things being equal, be expected to do good work, or better than imperfect machinery, a certain amount of good health is requisite for the accomplishment of any ordinary life-work.

Then there must be suitable consideration of the fact that were society built upon the principle of the "One-Hoss Shay," the wheels could not do the work of the thills, and so on, but each part could do its perfect work only by reason of the radical perfection of differences. So we are forced to regard the "perfect man" as one who is suited to his particular place and environment; and as development is only possible to its fullest extent when environment, opportunity, and ability are favorable, we will have to suppose a case to which the following applies:

1. Excellent physical and mental heredity has barred out the chances of consumption, insanity, liquor addiction, criminality, decrepitude, or ugliness.

2. As "every child has the right to be well born," so he has the right to good training, and our typical better man can only come from better folk with the right ideas of nurture.

3. This entails having not too many in the family, for the lower the race the more prolific; and highest culture is possible only, as a rule, where time can be devoted to the rearing and instruction of a few children.

4. The parents should have the direct supervision of the child's care, for among the very wealthy and the very poor neglect of children is too often the rule, and there is nothing in the world that can take the place of parental, especially motherly, love and care.

5. Circumstances do not permit one to develop as he will, or should; and as poverty produces thoughtfulness, thrift, and sympathy, and a better understanding of our neighbors' needs and characters, he who is unfortunate enough to be born wealthy should be brought into closer contact with the "other half" of the world.

6. As accomplishing something in the world is the only measure of adaptability, the means for such accomplishment should be sought, but not at the sacrifice of conscience,—whether acquired or ready made by ancestors.

7. He should be a man of fair size, because every one is inclined to discredit the possibility of a small man doing big things. Measure up your own list of heroes. Large-sized men are for this reason apt to be overestimated, just as titled individuals are who accomplish anything. Was it Huxley who said that Argyle was very smart—for a duke?

8. The *proper* regard for his individual interests will entail a genuine altruism which will make him not only a patriot (not of the demagogue kind) but a lover of liberty for the world. Kosciusco, Kossuth, Washington, Fayette, Garibaldi actively interested themselves in universal freedom when their own countries could spare their attention.

9. He could with great advantage be an American, for in America truth is left free to combat error; and no tyranny can be enduring under such auspices.

10. His education should be with regard to Herbert Spencer's idea that, first and foremost, that knowledge should be acquired which is of most practical worth to the individual, and that the ornamental should have last consideration. Overdoses of classical verbiage and minute details of the intrigues of courtiers would thus give place to physics and chemistry, which are of more account in this work-a-day world.

11. The cultivation of self-control, in the recognition that man is his own worst enemy.

12. Other desirabilities may be subclassed under the preceding. In a general way, and when aberrant types are excluded, the increase of the facial angle of Camper in the evolutionary scale has a value as an index to what nature does to increase intelligence. It is a very superficial physiognomical means of estimation, however, if associated matters are not properly considered at the same time, for the skull-growth may not keep pace always with brain-growth, in individuals or races, and complexity of convolutions may result to fold into smaller space the same amount of brain surface that may also be found with fewer convolutions in a larger, or more roomy, skull.

It is the multiplicity and complexity of the nerve-strands in the brain that causes intelligence, and these are developed by proper exercise and education of the senses in relation to the finer muscular movements. The learning of something to do that will benefit the world as well as self, and deep thinking thereon, and endeavoring to understand the universe, as far as possible, is best calculated to develop the brain most symmetrically, repress the evil and bring out all the good of which the highest type of man is capable, for goodness is but a high order of intelligence, notwithstanding its occasional absence in intellects otherwise highly developed, and its frequent presence among those whose minds are defective in other directions.

WHERE YOUNG AMATEUR PHOTOGRAPHERS CAN BE OF ASSISTANCE TO SCIENCE.

BY DR. R. W. SHUFELDT.

OF all the instruments that have come into use in the hands of science during the latter part of the present decade, none of them have been found so universally helpful as has been the camera. The photographic camera, with its modern multitudinous appliances, has made its power felt in the greatest variety of ways in all the departments of science, as in physics, chemistry, mechanics, astronomy, zoology, and each and the rest. But it is not my object to present an historical essay here upon this instrument, nor even to make the attempt to write out all I know about the operating of one in its details; it is merely my aim to bring a few practical hints before young photographers, and show them some of the new fields wherein, by patience and study, they can put their instruments to very excellent uses. As we all know, the art of photography is now easily acquired, and the producing of photographic pictures a pleasurable and sometimes a profitable employment. Yet how often it is that we see a young person purchase a first-class camera with its entire outfit, and after coming to be a good photographer, is satisfied at the end of a year or so with having filled a large album with pictures of the country around about his or her place of residence, or groups of friends, and perhaps a few other subjects, when the whole, save the album, is relegated to a corner in the garret. This is by no means a rare occurrence and the end of such enterprises.

I am a working naturalist, and a number of years ago conceived the idea that a good photographic outfit would meet a variety of ends in the course of my labors. A hundred dollars gave me one, and three times that amount of money would not induce me to part with it now. Including all my early failures, more than fifty per cent. of my pictures, and there have been a great many of them, have been published as illustrations to my scientific papers, and elsewhere.

PLATE XIII.

THE WESTERN RED-TAILED HAWK (*Buteo borealis calurus*). From a photograph.

When one comes to examine the figures of mammals, birds, reptiles, fish, and other forms that illustrate many of our older works in zoology, he can be but struck with the fact how wide of the mark the majority of them are. Indeed, it is frequently difficult to recognize the form of the animal that the artist intended to depict from the drawing he has made of it.

It was along such lines, as well as others nearly related thereto, that I hoped to introduce an improvement into my own designs. So simple are these steps that I feel sure that any painstaking young photographer can acquire and practice them, —and that, too, to profitable ends; to his personal enjoyment in the pursuit; or to the great assistance of others; or even to the advancement of learning; possibly to all of these combined.

A year or so ago I was collecting zoological and ethnological material in Northwestern New Mexico, and among many other things captured a great number of tiger salamanders (*Amblystoma tigrinum*), which were sent to biological laboratories all over the world. Now a salamander is a difficult subject to get a good figure of, and there are comparatively but few such throughout the entire range of zoological literature. This was my way of obtaining one with the camera: I fixed a small pine shelf perpendicular to the wall of my study at a convenient distance above the floor. This I covered with a large sheet of clean, white blotting paper, bending it so it hung down over the shelf in front, and likewise extended up over the wall behind. It was held in place by pinning it to the shelf with artists' thumb-tacks. Next placing any long, small object on the middle of the shelf in the place to be afterwards occupied by the salamander, we focus upon it with the camera, a strong light coming directly from behind the instrument. Insert your diaphragm with the smallest aperture, and remove the "dummy" from off the shelf. Now we are ready for the subject, and as it is very difficult to get one of these animals to lie still an instant, I waved over his nostrils, for a second or two, the fumes of a little sulphuric ether, and placed him in position on the shelf. As he recovered from the anæsthetic, he assumed a very natural attitude, and was perfectly quiet, allowing me to make an exposure of two minutes, and the

FIG. 1. — The Tiger Salamander (*A. tigrinum*); life size.

result was I obtained a good working negative.[1] The object of the blotting paper is to give a sharp figure, bereft of all surroundings, and that is one kind of picture largely demanded in zoological illustrations. Of course we *can* have all the grass, stones, and the rest of it that we want, but, as I say, that is not the kind of figure desired. The nap on the blotting paper usually gives a peculiarly soft background, and dead white in the reproduction made from the negative.

In nearly all cases such a negative should be *intensified* by the usual method with bichloride of mercury and the ammonia bath. It sharpens all the details of the figures, and makes a better print for the object in view. Now from such a negative a good photograph can be made upon sensitized albumen paper, and from this a drawing can be made. Or, any of the photo-engravers, by the various methods now employed, can make an electrotype from this negative, from which any number of figures can be printed. Yet again, you can make a print from it upon plain, non-albumenized, sensitized paper, which figure can be afterwards colored by hand from the original, and then handed to a lithographer for reproduction. Finally, one of the prints on this plain paper, can be delicately traced over by means of one of Gillott's mapping pens (No. 291) and Higgins' American drawing ink, and, when dry, the print can be submitted to a bath of saturated corrosive sublimate, and removes everything save what you have traced with your drawing ink. The "black and white" figure thus produced can be electro-

[1] Had not this negative, and the one described beyond of the Buteo, been broken just prior to having good prints made from them, they could have been used in the repro-

typed by any of the ordinary methods, at a very moderate cost, and it will make a fair figure to illustrate what the young naturalist may have to say in the journal he subscribes for,—as, for instance, the reports of any of the many chapters of the Agassiz Association to President Ballard. Excellent figures of fish may be obtained by any of the above methods, if you will but go to the trouble of constructing a glass tank of clear panes of window-glass, say 10x16, but only an inch or two apart, and parallel. In such a tank, filled with the very clearest of water, your ordinary-sized fish will be kept constantly in position and quiet. You can photograph through the double glass and the water, but you must only have the sky behind it for a background. To get an animal life-size you measure it with a pair of compasses, and compare this measurement with the image on the ground-glass of the camera, after you have finally focused to your liking. Your best stock of patience will be demanded in the photography of living birds. An entire chapter might be written upon this branch of the subject, and then it would hardly be exhausted. The same scrupulous care must be exercised in reference to position, the accessories, the backgrounds, and the rest of it. Very often we get excellent pictures from slightly wounded birds, and this was the case with the specimen of the Western Red-Tailed Hawk here offered in illustration. I made the photograph of this specimen in New Mexico in 1888.

It will be seen that I selected a rugged pine stump for him to stand upon, and this perch was sharply focused before placing my subject upon it. Further, it must be noticed that I secured a horizon; in other words, the hawk is brought out in strong relief against a good sky, which occupies the upper half of the figure. It would have been a simple matter to have placed a dead bird under one of his talons, but it was not done in this case; I have

duction of "half-tone" process figures. As it was, however, I had only secured prints fixed by hyposulphite of soda. So with the pentagraph. Mr. W. H. Chandlee, the artist of the U. S. National Museum, made the very accurate and beautiful drawings from them which illustrate this article. But even this method (in which the camera plays an equally important part) is as fully as useful, and one often resorted to by the artist who desires to obtain accurate and artistic illustrations in zoology. On this point see the author's letter to the editor in *The Auk* for April, 1891, entitled "Camera Notes for Ornithologists."

figures of owls wherein I have accomplished it. Where no background is demanded, such birds can be photographed in one's study, with a white sheet behind them, and against this cone-bearing pine boughs, old stumps, and the like, come out beautifully, and elegant figures of many kinds can be reproduced from the negative thus secured. A pneumatic snap-shutter is almost an indispensable adjunct to your camera in the proper photography of birds, as some of them have to be partially hypnotized before placed in position to be taken. Then, as they recover from the effect of this, they dress their plumage, assume a natural posture, and then appear animated. You now watch your opportunity, and secure an instantaneous picture of your feathered subject. In the forest you can often get most valuable negatives of nests and similar objects, all of which are highly prized by the scientific naturalist, and can be used in his work. Large lizards, such as our "Gila Monster" of Arizona, I have obtained by firmly strapping my camera in such a manner as to have the line of the focal axis perpendicular to the floor, upon which I have placed a sheet of white blotting paper, and then allowed the reptile to walk over it, and as he came beneath the lens, I secured a first-class negative of him. In the case of mammals, I have obtained photographs of dead ones, placed in natural postures, so faithfully done that they deceived the eyes of the best experts afterwards. My badger, published in *Forest and Stream* several years ago, was taken in that way, and very numerous other subjects, both since and before it.

The field and line of work I have briefly indicated above, is brimful of interest for the enthusiastic young naturalist, and one wherein he will soon find that all his ingenuity will be most amply demanded. As every faithful young biologist should keep his "journal" of observations made afield, and in the forest, or afloat, he will very soon find that his camera will aid him immensely in affording the means of furnishing permanent pictures wherewith to illustrate his remarks, and these in addition to the ones used from which his photo-electrotypes have been selected for printing.

PLATE XVI.

Carettochelys insculpta.

ON THE RELATIONS OF CARETTOCHELYS, RAMSAY

BY G. BAUR.

IN May, 1886, Prof. E. P. Ramsay, (1) of the Australian Museum, Sydney, described a peculiar new tortoise under the name of *Carettochelys insculptus*.[1] The description was based on an adult female (carapace, eighteen inches in a straight line), which was obtained in the Fly River, New Guinea. The new genus was referred to the family Trionychidæ, forming "a link between the river tortoise and the sea turtles." In 1887 Mr. Boulenger (2) placed this genus in a special family (Carettochelydidæ) of the Pleurodira, for the reason that the specimen was found in New Guinea, from which island only Pleurodira are known. The characters of this family were given as: "Plastral bones, nine. No epidermic scutes on the shell. Limbs paddle-shaped, with only two claws."

Prof. Gill, (3) nearly at the same time, wrote a review of Prof. Ramsay's paper, in which he reached the conclusion that the form is the type of a peculiar family, Carettochelyidæ, and that "it may quite likely prove to be a Pleurodire." Prof. Gill makes the following remarks: "But whatever may be the relations of the new genus, whether to the cryptodirous or pleurodirous tortoises, it has many quite peculiar characters. From all known forms it is apparently distinguished by the absence of scuta, the peculiar feet, and other characters. Undoubtedly, therefore, the new genus does not belong to any of the established modern families, and apparently not to any of the extinct ones named, although when more is known of Carettochelys, as well as the extinct forms, it may turn out that the Papuan animal is related to one of the families now regarded as extinct."

The family Carettochelydidæ of the Pleurodira was accepted by Mr. Lydekker (4) in the same year, and Hemichelys Lydekker, from the Lower Eocene of India, referred to it. In this

[1] In a preliminary note this form had been considered as a species of Cyclanoste:. The species must be named *insculpta*, not *insculptus*.

form we have five neuralia in contact with each other, and there was probably a small mesoplastron present, according to Lydekker. To conclude from the figure, it seems that there were eleven peripherals on each side, as in the Pleurodira, for instance. I believe, therefore, that it is more likely a Pleurodiran than a near relative of Carettochelys.

In 1890 I published a short note on Carettochelys, (5) in which I doubted the Pleurodiran nature of the genus. I said: "It is true it belongs the Papuarian region, in which, so far, only Pleurodira have been found. There are some characters, however, not seen in the Pleurodira, but in another group of Chelonians consisting of the families Cinosternidæ, Staurotypidæ, and Pseudotrionychidæ. It is only in this group that we find twenty-one peripheralia (marginal bones), as in Carettochelys; the neural bones are also reduced, and the dermal shields have disappeared entirely, as in Pseudotrionyx; to the latter character, however, I attach little value, as it may occur in any family.

"It seems to me that the systematic position of Carettochelys is far from being clear. How easily could the whole question be settled! Mr. Ramsay would do a great service to science if he would undertake to have the cervicals and the skull extracted, or the cervicals alone, if he fears for the skull. This could be done without injuring the specimen, and the structure of these parts would show at once the affinities of this peculiar genus."

Not doubting that Carettochelys would prove a very important form of the Testudinata, I wrote to Prof Ramsay, asking him if he could not examine the osteology of the animal, and publish a note about it. A short time before I received an answer I read Dr. Alexander Strauch's Bemerkungen über die Schildkröten-sammlung im zoologischen Museum der kaiserlichen Akademie der Wissenschaften zu St. Pétersburg. (6)

Dr. Strauch, whose classification of the tortoises is far behind the times, and certainly not accepted by anybody—(he does not distinguish the Pleurodira from the Cryptodira, but places them in one group, Testudinida, of the same rank as the Cheloniida! The unfortunate separation of Dermochelys as a suborder Atheca is still kept up!)—places Carettochelys in a special "Abtheilūng"

of the Thecophora, with the name Carettochelyda. " Rückenschild herzförmig mit Randknochen. Brustschildknochen zu einer Platte verwachsen. Schale ohne Hornplatten Floasenfüsse mit 2 Krallen. Phalangen der Zehen mit Condylen." Strauch remarks: " Soweit sich nach der allerdings noch sehr unvollkommenen Beschreibung Ramsay's urtheilen lässt, muss seine *Carettochelys insculpta* unbedingt zum Typus einer besonderen, den Trionychiden und den Meerschildkröten gleich werthigen Familie (nach Boulenger also Superfamilie) erhoben und im System zwischen diese beiden gestellt werden."

Shortly after I had read Dr. Strauch's paper I received an answer from Prof. Ramsay, which I will give in full: " I received your note on Carettochelys in due time, but owing to the internal alterations going on in the museum the specimen could not be got at, and it is only now that I have been able to examine it. Alas! there were *no cervical* vertebræ to examine; the animal had served the explorer for food, and the whole of the bones, except the skull, had been cut away. I had this photographed for you, and hope it will help to place the very interesting form in its proper place. I shall be glad to help you in any way; but there is nothing to work on, more than I have given in the Proc. Linn. Soc. N. S. W., Vol. I., 1886, p. 158, with plates."

This was bad news. Nothing left of the bones but the skull! But probably it was possible to determine the systematic position of the interesting animal from the photographs, which were on the way. A few days after the letter the photographs came: 1, two upper views of the entire animal; 2, one lower view; 3, the upper view, and 4th, the lower view of the posterior portion of the skull. To Prof. Ramsay I have to express my best thanks for his great kindness and liberality.

The skull at once showed that this form was no Pleurodiran; that its nearest living relatives appeared to be the Trionychia, its very closest fossil relative the peculiar Pseudotrionyx Dollo, from the Eocene, which I always had suspected as such.

The skull is only comparable with that of the Trionychia. As in this group, we have three greatly developed, crest-like posterior processes: the supraoccipital, and on each side the squamosal. The

supraoccipital process is club-shaped and enormously developed, —more than in any other tortoise known. Of course this character alone would not be sufficient to establish absolutely the near affinity of the peculiar form with the Trionychia; such a development of the posterior portion of the skull could take place in the Pleurodira or Cryptodira just as well. But there are other characters which at once show that the form has nothing to do with the Pleurodira. Before all, the pterygoids extend behind between quadrate, basisphenoid, basioccipital, a condition never seen in the Pleurodira. Whether the pterygoids are completely separated by the basisphenoid as in the Trionychia cannot be seen from the photographs; this question, therefore, is still an open one. The quadrate is peculiar. The articular face with the lower jaw is Trionychian, not Pleurodiran; and so is the posterior end of the lower jaw. The quadrate is not completely closed behind, but only on its outer border, as in Podocnemis, for instance, but not in such a great degree. As is well known, the quadrate of the Trionychia is completely closed behind; this, of course, is a secondary condition, and there cannot be any doubt that the ancestors of the Trionychia had the quadrate open behind. The quadrate of Carettochelys is exactly of such a form which we may expect in the ancestors of the Trionychia. The pterygoids resemble very much the same elements in the Trionychia. The lower jaw is rounded in front and has a short symphysis. The upper side of the skull is very interesting. The greatest peculiarity is that the upper surface of the bones is granulated exactly as the shell. The dermal plates described by Ramsay do not exist; there are no plates on the skull at all. This peculiar condition is only found in the Jurassic *Compsemys plicatulus* Cope. The sutures of the bones of the upper side of the skull, which can be seen, just as the sutures of the elements of the carapace and plastron are visible, must have been taken as indications of dermal plates by Prof. Ramsay.

The interorbital space is very large, the orbits being completely lateral; the postorbital arch is about half of the interorbital space. The whole upper aspect of the skull reminds us of the Dermatemydidæ, Staurotypidæ, Cinosternidæ; and the arrange-

PLATE XIV.

Carettochelys insculpta.

PLATE XV.

Carettochelys insculpta.

ment of the elements is the same, the frontals being excluded from the orbits. There is no indication in the photograph of free nasal bones. The nose is projected much in front, and must have, when in fresh condition, an appearance very much like that in the Trionychia, but not so much pointed. The zygomatic arch is not elevated as in the Trionychia, but is in a line with the maxillary and quadrate, as in the Cinosternidæ, for instance.

The neck, the vertebræ of which were unfortunately not preserved, was short; but I do not see any reason why the head could not have been retracted, as in the Chelydridæ, for instance Nothing is known about the shoulder-girdle and the pelvis. But one thing seems to be sure: the pelvis was not coössified with the carapace and plastron, but free. If it had been coössified with the shell, as in the Pleurodira, it probably would have been preserved with the shell. An important question is the number of phalanges in the fourth digit; as is well known, in all Trionychia we have more than three phalanges in the fourth digit. It looks to me, as far as I can conclude from the photographs, that in Carettochelys the number three was not surpassed.

We have now to consider the carapace and plastron. Both have been figured by Ramsay, but there was some doubt about the presence or absence of a mesoplastral element. In regard to the carapace, I have nothing new to add. There is no trace of dermal scutes on the shell. The number of neurals is six; they are very slender and all separate from each other. The first six pleuralia meet in the middle line behind, being separated in front by the neuralia. The seventh and eighth neuralia touch each other completely in the middle line. There is only one postneural. The number of the peripheralia (marginal bones) is ten on each side, besides the single pygal. The most interesting new point to be noted in the plastron is the presence of a small distinct mesoplastral element. The structure of the plastron is best seen from the figure.

I have stated above that Pseudotrionyx is the nearest relative of Carettochelys. Pseudotrionyx was described by Dollo (6) in 1886. The portions found in the Middle Eocene of Belgium consisted of the posterior part of the carapace, and the nearly complete hyo-,

hypo-, and xiphiplastron of the right side. The sculpturing o the shell is the same as in Carettochelys. There is no trace of dermal scutes. The number of the peripheralia is the same as in Carettochelys. There is only one postneural, of the same shape as in this form. There is a difference in the neuralia, however. There are seven slender neuralia in Pseudotrionyx, which are all connected with each other, separating the first six pleuralia completely; the seventh pleuralia meet behind, and the eighth are entirely connected. In all the pleuralia the rib heads are well developed. If we now compare the plastron of Carettochelys with the portions preserved in Pseudotrionyx, we are struck at once by the enormous resemblance. The hyoplastra of both are nearly identical in shape. I may call especial attention to the border connecting the hyoplastron with the endo- and epiplastron. But to conclude from Dollo's figure, it seems to me that the hyoplastron was not entirely united to these elements, but only connected with them by ligament, as in the Cinosternidæ. The most interesting point, however, is that Pseudotrionyx doubtless also had a distinct mesoplastral element as Carettochelys. Dollo held the opinion that there was a small fontanelle at the outer border of the hyo- and hypoplastra (Échancrure naturelle, reste d'une fontanelle latérale, N. Fig. I., Pl. II.) Besides, he thinks that the line of the connection between carapace and plastron was very short. There cannot be any doubt, however, that Pseudotrionyx showed about the same conditions as Carettochelys.

Pseudotrionyx is placed by Dollo, Zittel, and Lydekker among the Chelydridæ. A skull originally referred by Sir R. Owen to Platemys is considered by Lydekker (8) as belonging to Pseudotrionyx. It is stated that it agrees essentially with that of Macrochelys; and that this reference is confirmed by the total absence of the impression of horny shields, indicating that the skull, as in the Trionychidæ, was merely covered with skin. I think it is at least doubtful whether this skull belongs to Pseudotrionyx.

We have now to consider the relations of Carettochelys. Its nearest relative is, as I have shown, Pseudotrionyx. There is no idenceev from the present material that Pseudotrionyx belongs to

a different family from Carettochelys. I do not hesitate, therefore, to place both genera in one family, Carettochelyidæ Boulenger, 1887, which name has the priority before Pseudotrionychidæ Boulenger, a family established in the Encyclopedia Britannica, (Vol. XXIII.), p. 457, to contain Pseudotrionyx Dollo and Anostira Leidy.

This family may be characterized in the following way:

CARETTOCHELYIDÆ.

Shell without epidermal shields. Plastron composed of eleven elements, two small mesoplastra being present, which are separated from each other. Only ten peripherals on each side, besides the single nuchal and pygal. (Carettochelys, Pseudotrionyx.)

Upper surface of skull covered with small, round, raised rugosities exactly as the shell, with three posterior processes, as in Trionychia; skull resembling in shape that of the Cinosternidæ, but snout more projecting. Limbs paddle-shaped; digits much elongate, only the two inner clawed. (Carettochelys.)

How far Pseudotrionyx agrees with Carettochelys in the latter characters, new finds have yet to determine.

The question now is, To which group of tortoises does this family belong? In a former paper I distinguished four groups of tortoises: the Amphichelydia, Cryptodira, Pleurodira, and Trionychia. Of one thing we are sure: it does not belong to the Pleurodira. Unfortunately we do not know the structure of the cervicals, which is so characteristic of the three remaining groups. From all that is at present known, it appears to me that the Carettochelyidæ are nearest to the Trionychia, but show at the same time characters of a group of Cryptodira, composed of the families Staurotypidæ and Cinosternidæ. I expressed a few years ago the opinion that the Trionychia did come from forms which had the peripherals complete, and carapace and plastron closed; that the Trionychia are not an original, but a highly specialized group. Carettochelys shows in the structure of the skull, especially of the posterior portion, Trionychian affinity. I believe that the ancestors of the Trionychia consisted of forms

which in the structure of carapace and plastron were very much like Carettochelys. On the other hand, there seem to be connections through Anostira with the groups of Cryptodira named above. These affinities are shown in the shape of the skull and plastron, and the peculiar number of peripherals. Until the cervicals and pelves are known, I think it is impossible to determine the correct systematic position of the Carettochelyidæ. The most probable view seems to be this: The Carettochelyidæ came from a group of tortoises related to the stock from which Staurotypidæ and Cinosternidæ developed. It is probable that the Carettochelyidæ are very close to the ancestors of the Trionychia, of which they are only survivals. For the ancestors of the Trionychia we have to look in the Jurassic and Lower Cretaceous; for I have shown in another paper that the Trionychia of the Upper Cretaceous (Laramie) are typical forms, in which the peripheralia had been already entirely reduced. I have little doubt that these started from the Amphichelydia.

There are some points which could be made out by examination of the unique type specimen of Carettochelys; the entire structure of the skull, for instance, the condition of the first dorsal, which is probably preserved. It would be very important to know whether the premaxillary is small and single, as in the Trionychia, or whether it is developed, as in the Staurotypidæ, for instance. It would be interesting to know whether the anterior part of the centrum of the first dorsal vertebra is modified as in the Trionychidæ or not.

I can only hope that new specimens will be collected soon in New Guinea. They doubtless exist there in great numbers, and I think the time will not be very far away when we will know the whole anatomy of this most interesting tortoise.

Clark University, Worcester, Mass., April 5th, 1891.

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EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

IT is generally conceded that it is important to avoid the duplication of names of like rank in the nomenclature of each of the great divisions of organic life. A genus of plants may bear the same name as a genus of animals, but no two genera of either must bear the same name. There has, however, recently developed a difference of opinion as to what constitutes identity of name. It was for a long period assumed that any difference is a difference, and that words identical except as to masculine or feminine termination are different words. Thus no one thought of regarding Picus and Pica as duplicates, and the two appeared together in ornithologies for nearly a century. But the desire for change stimulated somebody to consider the use of one of them a duplication of the other, and a new name was proposed to take the place of the one which was introduced latest. Following this example, numerous changes have been proposed for the same reason. But there are other instances where the difference extends to two letters, as in the case of Menodus and Menodon, and here also change has been introduced. If a difference of two letters is not enough to preserve two names, it becomes a question how many letters will constitute diversity, and so on. There seems to be a preference also that a difference of a letter in the beginning of a name is of greater moment than such a difference towards or at the end of a name. Thus no one has proposed to change the name Tinodon because there is also a name Dinodon, or Momus because there is a Mimus, or Mora because there is a Mola. The number of changes which may be made on such grounds as these is very great, and the name-changers have yet a large field before them.

From another point of view we can see that if differences of one or two letters are not admissible, we are debarred from the use of a large proportion of possible names. Thus we cannot have Manodus nor Monodus, nor Melodus nor Tenodus, nor

Henodus, nor Menopus, nor Menotus, on account of Menodus, and so on *ad infinitum.* The fact is, the changing of a name which differs by a single letter from another name has no warrant in any rule, or in common sense. The changing of names is an inconvenience to be avoided as far as possible, and the zeal frequently seen to make such changes without sufficient ground should be abated. When the correct spelling of a name makes it identical with another, change is necessary, since a name is only recognizable when correctly spelled. Science is nothing if not accurate.

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RECENT LITERATURE.

Catalogue of Fossil Reptilia and Batrachia (Amphibia) in the British Museum, Parts II., III., and IV.[1]—Dr. Lydekker includes in Part II. the orders Ichthyopterygia and Sauropterygia; in Part III. the Testudinata; and in Part IV. the Placodontia, Theromora, and the Batrachia (Amphibia). Part I. included the Archosaurian series (Dinosauria, Crocodilia, and Ornithosauria) and the Squamata. The order of treatment has not been a systematic one either ascending or descending, possibly for reasons connected with the administration of the museum. Apart from this, we are disposed to find fault with some features of the system adopted which are more important. Thus the streptostylicate series is quite heterogeneous, including the Rhynchocephalia, which must go with the Dinosauria in the Archosaurian line; and the Ichthyopterygia, which belong in the Synaptosaurian series. The Rynchocephalia of Lydekker, however, include some types (as Rhynchosauridæ) which, from their single coössified postorbital bar, belong in the Synaptosauria.

In the treatment of the detail of the subject embraced by these catalogues we find the conscientiousness and painstaking characteristic of the author's work generally. The definitions are comprehensible, and the treatment of material judicious so far as appears. The settlement of questions of affinity and synonymy left uncertain by the older paleontologists is a service for which students everywhere will be grateful. This was especially needed among the Testudinata, which Dr. Lydekker found in great confusion, but which he has reduced to comparative order. We have to thank him for the abolition of the name Colossochelys, which cannot be distinguished from Testudo. Some of his genera are probably too comprehensive, as, *e. g.*, Cimoliasaurus (Sauropterygia), as the author himself suggests. Trionyx also probably includes more than one genus. Here is also the place to correct some statements of the author anent the Adocidæ. He remarks (p. 129): "The so-called Adocidæ of Cope are probably also referable to the Dermatemydidæ, the abortion of the ribs not being a character of family value. In the Cretaceous genus Adocus there are traces of vermiculation, which are more distinct in the Eocene genus Agomphus, and it has yet to be proved that the latter is really distinct from the

[1] Catalogue of the Fossil Reptilia and Amphibia in the British Museum. By Richard Lydekker. Part II., 1889; Part III., 1889; Part IV., 1890. London. Published by the trustees of the British Museum.

under-mentioned genus" (Trachyaspis). The fact is, that, as I showed in 1873 (Ann. Report U. S. Geol. Surv. Terr., 1872, p. 621), Adocus has an intergular plate, and a simple contact of the inferior pelvic bones with the plastron, and is allied to Baëna, belonging therefore to Lydekker's group Amphichelydia; and the absence of rib-heads is not included in my family definitions. Also Agomphus has no trace of vermiculation, while they are strong in Trachyaspis.

We refer to some points of nomenclature which arrest our attention. The author establishes a "new family," Dermatemydidæ, and then remarks that the "so-called Adocidæ" belong to it. Should this be the case, the proper proceeding would have been to have placed Dermatemys and allies in the Adocidæ. The name Anomodontia is used instead of Theromora for the order first defined by the present critic under the latter name. Both Prof. Owen's first and last use of the former term are shown by Lydekker to have been for the division to which the later name Dicynodontia has been also applied. The latter name should be disused, both because it is a synonym and because some of its members are edentulous. Dr. Lydekker is probably correct in preferring the name Theriodonta to that of Pelycosauria, as they may refer to the same natural division, although the evidence is not all in yet. The name Cotylosauria, though proposed with an erroneous definition, is probably the proper one to apply to the subdivision Pareiosauria, while Proganosauria should be probably used in place of Procolophonia. The term Labyrinthodontia is resuscitated and used for the Stegocephali, although its original definition and etymology render it applicable to a limited subdivision only, whose actual boundaries are not yet known. In the division of the Stegocephali into orders or suborders considerable difference of opinion has developed. The obvious and simple division into Ganocephali, Rhachitomi, Embolomeri, and Microsauri is objected to by Lydekker, Zittel, and Fritsch, on grounds which seem to the present critic insufficient; and the classifications which it is proposed to substitute appear to stand on unsecure foundations. The value of the presence of complete intercentra in the cervical and dorsal regions in Embolomeri is said to be destroyed by the fact that Archegosaurus (Ganocephali) possesses the character in the *caudal* region; very inconsequent reasoning, it appears to us. Objection to the systematic importance of the segmented or rhachitomous structure is based on the fact that it is present in young Labyrinthodons, etc. This is certainly a new reason for discarding a character from systematic biology. When a character is shown to be inconstant in adults it should be relegated to the rear, but not before. That this may prove to be the case with the rhachitomous vertebra may

yet be discovered, but it has not been as yet; and it will not be soon observed with the embolomerous structure.

The author's adhesion to the law of priority in specific and generic names contributes much to the simplification of nomenclature. He is not as strict in the matter of family names. We cannot agree with him in changing a name as preoccupied, so long as it differs from the supposed preoccupier by one letter. This is not preoccupation.—C.

A. S. Woodward's Fossil Fishes.[2]—The fine collection of fossil fishes contained in the British Museum has been at last utilized as the basis of a systematic work. No better appointment could have been made for the accomplishment of this purpose than Mr. A. Smith Woodward, whose abilities as a systematic zoologist have been amply tested in this difficult field. The first part of the catalogue is devoted to the Elasmobranchii. Two hundred and ninety-six species are contained in the museum collection, which is only a part of those actually known. The value of the work is greatly enhanced by the reference list of all described species given under the head of each genus. Of the above species, twenty-four are included under the Ichthyotomi, of which fourteen are Pleuracanthidæ, and the remainder Cladodontidæ. The systematic position of the latter family is for the first time thus indicated. The doubts expressed as to the segmentation of the skull of Didymodus, expressed in this place by Mr. Woodward, have been since set at rest by an inspection of the specimens themselves, as he acknowledges in his report on American collections published in the *Geological Magazine* at a later date.

In the second part of the work Mr. Woodward takes in hand the question of the systematic relations of the fishes in general. He discards the division Ganoidei as unavailable, and adopts the subclasses Elasmobranchii, Holocephali, Dipnoi, and Teleostomi, as has been done in this country. He does not adopt the Agnatha, but accepts the superorder Ostracodermi[3] Cope, which, according to some authors, represents the former in the Paleozoic formations, and places them as a fifth subclass of the Pisces. This is a great advance over previous views held in Europe, and it now remains to be seen whether the opinion that the Ostracophori are outside the class of fishes is to be sustained by further discovery or not.

[2] Catalogue of Fossil Fishes in the British Museum. By Arthur Smith Woodward. Part I., 1889; Part II., 1891. Published by the trustees of the British Museum.

[3] This name was used by Gill in 1861 for the Scleroderm Plectognath fishes. I regret the apparent necessity for changing it, and propose the term Ostracophori to take its place.

Another important point is the definite location of the Acanthodii as a third order of the Elasmobranchii, for what appear to be entirely valid reasons. These are quite sustained by the results of a study of several species of Acanthodes, published in 1890 by Dr. Otto Reis, in a paper which had not probably come into Dr. Woodward's hands in time for notice.[4] The next important systematic step is the location of what is left of the old Placodermi after the abstraction of the Ostracophori, represented by the Coccosteidæ. These Dr. Woodward regards as Dipnoi, and the view is a plausible one. Doubtless paleontologists have no better place for them, and new evidence is likely to confirm the proposition. He names the order the Arthrodira.

Two orders of Teleostomi are adopted, the Crossopterygia and Actinopterygia; the Rhipidopterygia and Podopterygia being rejected. We have given reasons in the NATURALIST for April why we think these orders (or better, superorders) should be retained. Under Crossopterygia, four suborders are recognized,—viz., Haplistia (Tarrasiidæ); Rhipidistia (Holoptychiidæ, Rhizodontidæ, Osteolepididæ, and Onycodontidæ); Actinistia (Cœlacanthidæ); and Cladistia (Polypteridæ). The Actinopterygia are divided into two sections, A and B, corresponding to our Podopterygia and Actinopterygia respectively. The present work enters only the former division, which includes the families Palæoniscidæ, Platysomatidæ, Catopteridæ, Chondrosteidæ, Belonorhynchidæ, Acipenseridæ, and Polyodontidæ. The volume concludes with the Platysomidæ.

Many important points in the structures of these fishes are discussed, and the species which are included are placed on a permanent basis. The work is illustrated by numerous good lithographs.—C.

Mrs. Bodington on Evolution.[5]—This book, of two and a quarter hundred pages, is a popular presentation of many of the facts discovered by the more modern laborers in several fields of biology. Its nine chapters treat of the following subjects: The evolution of the eye; extinct and surviving mammalia; the flora of the past; interesting facts in evolution; microörganisms as parasites; puzzles in paleontology; the air-bladders of fishes; Neo-Lamarckism; the origin of the fittest. The authoress' presentation of these topics is both graphic and scientific, and is well calculated to interest the gen-

[4] Zurkentniss des Skelets der Acanthodinen, von Dr. Otto M. Reis; Geogn. Jahreshefte des Kgl. bayer. Oberbergamts, 1890.

[5] Studies in Evolution and Biology. By Alice Bodington. London: Elliott Stock, 8vo, 1890.

eral reader. In fact, the work is an excellent one to put into the hands of any person without scientific knowledge, who desires to get an insight into questions that occupy at present the scientific mind. An especial interest will attach to the book, in the minds of Americans, because many of the facts and conclusions described are derived from the work of their countrymen. This will be a recommendation to those foreign readers who do not desire the labor of searching the original sources in our scientific literature, for popularizers of American biologic work have not yet grown up on our own soil. The authoress is the wife of an English physician who lived at Vancouver, British Columbia, and is still a resident of that beautiful region.

Mrs. Bodington has become a Neo-Lamarckian in her views after an impartial examination of the evidence offered by paleontology, and she says: "Neo-Lamarckism supplies the 'motif' which runs through almost every study in this little book. I had not met with the works of Lamarck when these studies were written, yet it seems to me that every advance in the physical sciences which I have endeavored to chronicle adds a fresh laurel to the fame of this most unjustly decried genius. If we, who love and honor the name of Darwin, look upon him as the Newton of evolution, we surely shall not detract from his fame if we look upon Lamarck as its Galileo."

General Notes.

GEOGRAPHY AND TRAVEL.

The Peary Exploring Expeditions for Greenland and the Survey of Unexplored Regions of the Arctic Circle.—An expedition that promises to the promoters and to science generally discoveries and result of interesting import now takes the name of the North Greenland Exploring Expedition. It has been fitted out by an experienced investigator, Lieutenant Robert E. Peary, who is a civil engineer, serving in the navy with the rank of lieutenant, and for the past two years stationed at the League Island Navy Yard, Philadelphia. He has obtained a long leave of absence in order to command this enterprise, which he has personally projected and arranged, contributing largely to the necessary expenses. His former experience in the far north fit him thoroughly for his work. Five years ago he penetrated far into Greenland with a companion, and obtained a knowledge that is the basis of his present project of reaching and exploring the most northeasterly promontory of Greenland, and, if the conjectures of the existence of a polar open sea be well founded, to secure all the information obtainable about that ocean.

Among the first to see the promise of Lieutenant Peary's project were the members of the Philadelphia Academy of Natural Sciences. This institution not only extended sympathy and support, but organized a special auxiliary corps, with this personnel: Professor Angelo Heilprin, Curator-in-Charge of the Academy, will be the geologist and leader of the party; Professor Benjamin Sharp, M.D., Ph.D., also of the Academy, will be the zoologist; Professor J. F. Holt, Professor of Natural History at the Philadelphia High School, also zoologist; Dr. William T. Hughes, ornithologist; Mr. Frazer Ashhurst; Dr. Robert M. Keely, assistant ophthalmologist at the Jefferson Medical College, Philadelphia, surgeon; Dr. William H. Burk, botanist; Levi W. Mengel, Ph.G., of Reading, Pa., entomologist; and Alexander C. Kenealy, journalist.

For the voyage a diminutive but staunch steam yacht, called the "Kite," has been secured. She was built expressly for sealing trips, and has buffeted the ice-floes of Norway for nearly eighteen years, and although perfectly sound, has been strengthened and put in order

for the proposed heavy work, and supplied with every means that experience can suggest to fit her for the work.

The dimensions of the "Kite" are 117.6 feet long over all, 26.4 feet beam, and 14 feet hold. Her tonnage is 280 gross and 190 net. The engine is a vertical one of fifty-horse power, placed well aft, so as to give the propeller a short crank shaft, and thus lessen any liability to breakage. The propeller can be triced up and the rudder unshipped in thick ice. Her speed is from seven and one-half to nine knots. Her bow and sides are well protected with heavy pieces of iron and dovetailed blocks of wood.

The vessel will be commanded by Captain Richard Pike, who went with Lieutenant Greely in 1881, and was also one of the Greely rescue party in 1883. His crew will consist of chief mate, Edward Tracy; boatswain, Patrick Dunphy; chief engineer, William Jardine; second engineer, Alexander McKinley; steward, Lawrence Hackett; assistant steward, Patrick Welsh; cook, Thomas Pepper; firemen, Andrew Roost, Edward Crook, and John Cunningham, and able seamen, Thomas Collins, John Cummings, Timothy Looney, and John Verge. McKinley is from Glasgow, and Pepper from London. The others are Newfoundland seal fishermen.

Lieutenant Peary will be accompanied by his wife and five hardy seamen who have experienced the rigor of polar winter weather, and they are to stick to him in all his operations and movements. So the entire ship's company will consist of thirty persons. There will also be four large Newfoundland dogs on board.

The "Kite" sailed from New York, in June last, direct to Ivigtut, a coaling station at the southernmost point of Greenland, just back of Cape Farewell. From thence the "Kite" will proceed to Upernavik, on the northwestern coast, in latitude 73°. This is the northernmost Danish settlement of Greenland. From Upernavik the "Kite" will break her way through the ice across Melville Bay, around Cape York to Whale Sound, where Lieutenant Peary, his party, and all their supplies will be landed.

It is expected that it will take a month to reach Whale Sound, where a house will be built for Lieutenant Peary and his wife, who will accompany him on his long journey. At this point the North Greenland and the West Greenland parties will separate. The North Greenland expedition will start out and establish provision stations to the northward and eastward. About a year will be consumed in making these preparations, and it is not expected that the actual business of that part of the expedition will be begun until the

summer of 1892. Lieutenant Peary will then take a northeast route, skirting the coast, but keeping on the unbroken inland ice. As the party proceeds, their route will bend to the northward and reach the furthest point north of the Greely expedition. From that point an effort will be made to reach the northern terminus of the land and determine its character, and also the existence of an open polar sea. At the same time the Academy of Sciences corps will proceed southward. Lieutenant Peary states that he will make journeys from station to station on snow-shoes and ice-skates or skias, while provisions will be transported by Eskimo dogs and by members of the party. It is believed by Professor Heilprin and others that the party will reach within 350 miles of the North Pole by traveling, it is estimated, about 1,200 miles to and from the main station. This journey will consume about three months, including rests, and the daily journey will cover from eighteen to twenty miles. He proposes to see if the region of the North Pole is of land or water, and hopes to discover the polar open sea.

GEOLOGY AND PALEONTOLOGY.

The Name Huronian.—Professor Alexander Winchell, in the Bulletin of the Geological Society of America, Vol. II., pp. 85–124, remarks as follows:

"Clearly, the interests of geology and of truth demand an adjustment of these conflicting conditions in terminology. If Sir William Logan unwittingly extended the term Huronian over two systems now known to be distinct, that usage cannot be continued. Either the name must be restricted to the upper system, or it must be relegated to synonymy. We think it may be appropriately attached to the upper system. The early Canadian geologists sought a term which would cover, first and chiefly, the great quartzites which were found to follow the Silurian strata in downward succession. Underneath were seen so-called chloritic schists and a slate conglomerate. In the region first studied these were seen to rest on crystalline rocks, and appeared to fill completely the gap between the Silurian and the gneisses. These strata were all conformable, and evidently constituted a system. If it had not been previously named, the Canadian geologists conferred a service on science in giving it a designation.

"Soon, however, older schists than these were described; but since their structural discordance with these was not striking in the original

region, as known thirty years ago, and since their conglomerate and slaty characters were similar to those in some strata of the system first named, it was natural, or at least it was venial, to include these latter with the former. If, now, we have learned that they are geologically incongruous with the higher, it appears obviously necessary to drop them off, however prolonged the period in which they have been associated together.

"This is the view which we have maintained for several years. We have insisted that the so-called Huronian of Lake Superior is an older system than the Huronian of Lake Huron. But we were not aware, it must be confessed, until our recent studies, that the same older system was actually present north of Lake Huron.

"If, then, we restrict the term Huronian to the upper system, it remains attached to the best-known and characteristic portion of the old complex Huronian. There will remain the older system, not distinctively named until Dr. Lawson in 1866 bestowed upon it the name 'Kewatian.' In volume, in petrographic and stratigraphic characters' it is a system. It should therefore receive a name of systemic form. Such name is Kewatian, homophonous with Huronian, Silurian, and the remaining systemic names.

"Whether the term Huronian must not yield to the priority of Taconic or Cambrian, we will not discuss. Whether Kewatian can take precedence over Azoic, Taconic, and Cambrian, remains to be decided. It is the misfortune of all these names, except Kewatian, that they were originally intended to cover a complex of strata which has been proved to constitute two distinct systems."

Pre-Paleozoic Surface of the Archean Terranes of Canada.—Mr. A. C. Lawson has collected evidence to show that the hummocky aspect of the Archean terranes of North America is not due to the action of the ice of the Glacial epoch, but that it was characteristic of the surface upon which the earliest Paleozoic sediments were deposited. In pursuing the work incident to this paper, Mr. Lawson found also excellent presumptive evidence that the greater part, if not the whole, of the Canadian Archean terranes were at one time covered by Paleozoic strata. (Bull. Geol. Soc. Am., Vol. I., pp. 113–174.)

A Mesozoic Fish Fauna in New South Wales.[1]—Mr. A. Smith Woodward has recently published a memoir on some fossil fishes

[1] The Fossil Fishes of the Hawkesburg Series at Gosford. By A. Smith Woodward, F.Z.S., F.G.S. Memoirs of the Geological Survey of New South Wales. Paleontology, No. 4.

collected by Mr. Charles Cullen at Gosford, New South Wales. The series comprises nearly four hundred specimens obtained from a layer of dark-gray shale, four feet thick, interstratified with the massive beds of sandstone belonging to the Hawkesbury formation. As a result of Mr. Woodward's researches, they have been classified as follows: One Dipnoan, possibly allied to Ceratodus, *Gosfordia truncata*. Of the family Palæoniscidæ, *Myriolepis clarkei*, *M. latus*, *Apateolepis australis*; of Catopteridæ, *Dictyopyge symmetricus*, *D. illustrans*, *D. robustus*; of Belonorhynchidæ, *Belonorhynchus gigas*, *B. gracilis*; of Semionotidæ, *Semionotus australis*, *S. tenuis*, *Pristisomus gracilis*, *P. latus*, *P. crassus*, *Cleithrolepis granulatus*, *C. ? altus*; of Pholidoporidæ, *Pholidophorus gregarius*, *? Peltopleurus dubius*. All the species are new except *M. clarkei* and *C. granulatus*. Of the genera, Gosfordia, Apateolepis, and Pristisomus are new.

An examination of this list at once demonstrates that the fauna is of early Mesozoic age, and Mr. Woodward regards the Hawkesbury beds as homotaxial with the Keuper of Europe, or, at the latest, with the Rhætic. An important fact leading to this conclusion is the absence in this series of fishes with well-developed vertebral centra.

Ten plates accompany the text, from which one learns how much good work can be done with very fragmentary fossils.

A Cimoliosaurus from the Niobrara Cretaceous of Kansas.—Prof. Williston has recently described a Cimioliosaurus from the chalk of Western Kansas, which is of interest by reason of the nature and preservation of the remains. The specimen comprises the skull and twenty-eight cervical vertebræ, all attached, and with their relative positions but little disturbed. The entire length of the skull is about nineteen inches, its greatest height about nine inches. It is evident thas the skull was a long and narrow one, quite similar to that of *Plesiosaurus conybeari* Sollas. Prof. Williston describes for the first time the teeth of an American species.

Plistocene Subsidence versus Glacial Dams.—Prof. J. W. Spencer's studies of the old shore-lines, such as beaches, terraces, and sea-cliffs, in the northeastern part of North America, lead him to think that these shores were constructed at sea-level, and not moulded in glacial lakes. Under these conditions it is necessary to accept a great subsidence of the continent, in later Plistocene times, to nearly 2,700 feet in Western Pennsylvania. He also cites foreign examples to show that these continental movements are not peculiar to America, but that the record of subsidence may be read in the Barbadoes, in Asia, and in Europe. (Bull. Geol. Surv. Am., Vol. II., pp. 465–476, pl. 19.)

On Some New Fishes from South Dakota.—The Rev. D. S. McCaslin and the Rev. Wm. M. Blackburn have sent me some specimens of fossil fishes obtained by the latter gentleman from the Ree Hills in South Dakota. They are preserved on slabs of a soft, chalky rock, and are in pretty good preservation. The age of the horizon has not yet been determined. It is overlaid, according to Mr. Blackburn, by a thin layer of glacial drift. There are five species, all new to science. I describe them below, and reserve reflections as to their probable geologic age until their characters have been pointed out.

GEPHYRURA CONCENTRICA, gen. et sp. nov. Isospondylorum vel Haplomorum.—*Char. gen.*—Mouth small, the superior border formed by the premaxillary, the maxillary apparently not contributing; no teeth. Branchiostegal rays six, or probably seven. Dorsal fin median in position, short, originating above a point just posterior to the origin of the ventrals, and extending to a point above the anal fin. Vertebræ keeled, the last not modified by the development of hypural bones, but terminating abruptly, or gephyrocercal (Ryder). Caudal fin normal, and not elongate. Scales cycloid, with strong concentric grooves, and a few proximal radii crossing them. No lateral line discernible. Fins without conspicuous spines.

Char. specif.—The only specimen is broken vertically across the middle, and the posterior half shifted so as to lie immediately below its proper position. It appears that little or no part of the fish has been lost. Radii, P. 9; D. 9; C. 6–16–8; A. II 11. V. 1–6; vertebræ, 10–18. Scales in twelve longitudinal rows between dorsal and ventral fins, and equal in number to the vertebræ on the longitudinal line, or twenty-eight. Head covered with scales; five in a vertical line on the operculum. The dorsal, pectoral, and ventral fins are rather small. The caudal fin is probably not much forked, if at all. The orbit is large, but its outlines are not well preserved. The head enters the total length four and a quarter times to the base of the caudal fin-rays, and slightly exceeds the depth at the ventral fins. Total length, 61 mm.; do. of head, 15 mm.; do. to base of ventral fin, 24.5 mm.; do. to base of anal fin, 30 mm.; depth at ventrals, 14 mm.; depth at caudal peduncle, 6 mm.

This fish may belong to the Cyprinodontidæ. It is peculiar in the absence of the hypural bones, the caudal region resembling the type modified from the diphycercal, called by Ryder the gephyrocercal.

? SARDINIUS BLACKBURNII, sp. nov.—This fish is represented by a single specimen, which is in good preservation with the important ex-

ception that it lacks the head. Its generic position is therefore not positively determinable, although it is strongly suggested by the parts preserved. If not strictly a species of Sardinius, it is an allied form. The vertebræ have longitudinal fossæ; the hypural bones are well developed, and distinct from each other. The dorsal fin commences above the ventrals, and is of moderate length; anal not elongate. The spaces between the caudal hæmal spines are traversed by a slender rod obliquely downwards and backwards near the vertebræ. The scales are cycloid and with strong concentric grooves. Owing to the loss of many of the scales, the presence of a lateral line cannot be affirmed. One interneural in front of D. I.

Char. specif.—Radii, D. 1–7 (possibly one lost at the end); A. 8; V. crowded together, but not less than six. Caudal vertebræ, 17. Depth at D. I entering length to bases of caudal rays, 1.5 times. Depth of caudal peduncle, 2.25 in the same. Length from front of base of D. to end of caudal fin, 29 mm. Length of caudal vertebral series, 20 mm. Vertical depth of caudal fin, 22 mm. Length of base of dorsal fin, 6 mm.; elevation of do. 8 mm.

PROBALLOSTOMUS LONGULUS, gen. et. sp. nov.—? Isospondylorum. *Char. gen.*—Mouth small, ? superior, at the extremity of a prolonged muzzle. Dorsal vertebræ elongate, fossate; caudal vertebræ shorter. Pectoral fin median, lateral; dorsal above ventrals, median; anal small; caudal large, little emarginate. No conspicuous spines. Hypural bones distinct from each other. It is probable that the single species known is either scaleless or that the scales are extremely minute. The affinities of this genus are not exactly determinable, owing to the injured condition of the head. It may be allied to either of the two genera already enumerated. The remarkable production of the muzzle distinguishes it from either, as well as the elongate vertebræ, and corresponding width of the intercostal spaces.

Char. specif.—Radii, D. I 8; C. 6 21, 3; A. I 6; V. 10; P. 10. There is a break behind the skull, so that the number of dorsal vertebræ is uncertain; there were at least 13; caudal vertebræ, 18. The form of the postcranial regions is slender, the depth at the dorsal fin entering that region to the base of the caudal fin six times, and the total length ten times. The head enters the total minus the caudal rays, one and three-fifths times, or twice, including the caudal fin. The caudal peduncle is long, and its depth enters the total length minus the caudal fin, thirteen times; its length enters the total minus the head, two and one-half times. Total length, 87 mm.; approximate length of head, 29 mm.; of caudal vertebræ, 20 mm. Depth at ventral fins, 7 mm. Elevation of dorsal fin, 7 mm.

OLIGOPLARCHUS SQUAMIPINNIS, gen. et. sp. nov. Percidarum.—Apparently allied to Lepomis, but I cannot determine the presence of vomerine teeth or the number of the branchiostegal rays.

Char. gen.—Jaws with a few rows of conic acute teeth. Apparently no palatine or pterygoid teeth. Operculum without notch or production of the posterior angle or border. Bones of the head smooth, and not serrate. Scales ctenoid, with rough area externally and concentric grooves internally, and radii proximally. Spinous radii, D. X.; A. III.; P. I. Spinous dorsal continuous with soft portion, both together much larger than the anal fin. Caudal fin furcate. Skull with a median crest, from which a series of interneural bones extends to those supporting the dorsal fin. Lateral line not discoverable.

This genus appears to be allied to the Percid genera related to Centrarchus, which now inhabit North American waters. It differs from all of them in one way or another, as for instance in the form of the opercular border, or in the number of the spinous rays and their proportions. It is perhaps most closely allied to the extinct genus Plioplarchus Cope, differing mainly in the small number of anal rays; that genus possessing from five to seven. These differences are the same as those that separate some of the recent genera, showing that the same diversities existed in Cenozoic times as now. In the best preserved specimen I count six branchiostegal rays, but I am not sure that this is the entire number. The pubes are connected with the clavicles directly; vertebræ with lateral fossæ.

Char. specif.—This species is the most abundant, as many as twelve individuals having come under my observation. The largest is about equal in size to our smaller existing sunfish, *Lepomis pallidus*. Radii, D. X 9–10; C. 5, 17, 5; A. III 7–8; V 1–5; P. I 12. The dorsal spines increase regularly in length to the tenth; the first rises above the base of the ventral fin, which is a little behind the base of the pectoral. The anal fin commences below the first soft ray of the dorsal fin, and is nearly coterminal with the last soft ray of the same. The ventral spine is quite as robust as any of the dorsal spines, and is subquadrangular, with the external and posterior faces convex, and the anterior grooved. The anal spines are robust, the third the longest. The scales are in from twelve to fourteen longitudinal rows. In one specimen, of larger size than the others, there are seventeen rows. This probably indicates another species, but it is too imperfect for characterization. Scales rather smaller than those of the body extend on the interspinous membranes of the soft dorsal and caudal fins, and on the opercular and suborbital regions of the head. Vertebræ, D. 12, C.

16. Length, exclusive of caudal fin, 52 mm.; length of head, 18 mm.; do. to base of D. 1 (axial), 21 mm.; do. to base of ventral, 22 mm.; do. to base of anal, 35 mm.; depth at base of D. 1, 19 mm.; do. of caudal peduncle, 10 mm.; length of tenth dorsal spine, 8 mm. The specimen measured is one of the smaller ones, and is selected on account of its good condition. The larger specimen above mentioned measures 34 mm. in depth at the first dorsal spine, and the head is 28 mm. in length.

Mioplosus multidentatus, sp. nov.—Represented by a specimen nearly perfect, but wanting the caudal and anal fins. It conforms exactly to the characters of Mioplosus Cope in the distinct dorsal fins, the serrate inferior border of the preoperculum, the two anal rays, and the ctenoid scales. Radii: Br. VI (? +); D. XII–12; V. 6, no well-developed spine. Dorsal fins slightly separated at the base; the longest spinous ray the third; the first very short. Vertebræ, D. 14, C. 16, the last one counted possibly not the last, as its distal end is broken off. Scales in about twenty longitudinal rows at the ventral fins, and twelve at the caudal peduncle; with proximal radii coarse, and no concentric grooves. Posterior limb of preoperculum smooth; the inferior with nine robust teeth directed forwards. A serrated crest on the posterior part of the skull, which is either the superior branch of the posttemporal or immediately adjoins it. Eye large; muzzle short, not longer than diameter of orbit. Mouth opening obliquely upwards. Ventral fin originating a little in front of dorsal, its rays quite long. Anal originating below anterior ray of second dorsal. Depth of body at first dorsal a little less than one-third of length without caudal fins, and equal to length of head. Length of head, 35 mm.; do. to base of first dorsal, 41 mm.; do. to base of second dorsal, 75 mm. Length of muzzle to orbit, 11 mm.; depth of second dorsal, 23 mm. The proportions of this species are about as in the *M. abbreviatus*, and the number of scales as in *M labracoides*. The peculiarity consists in the increased number of spines of the first dorsal fin (nine in the other species), and dorsal vertebræ (ten in other species), and preopercular teeth (five in other species).

Geological Position.—The first observation to be made on the species above described is that they differ as to species, and three of them as to genus, from all others discovered elsewhere, both fossil and recent. The next conclusion is that they include no Cretaceous types, the only identification with a Cretaceous genus (Sardinius) being purely provisional. The third point is that the genus Mioplosus has been found hitherto in the Green River Eocene only. The age is

Cenozoic, but to which system the fauna belongs it is difficult to discover. None of the genera have been found in the Amyzon shales, and but one in the Green River shales, so that their pertinence to the Eocene fauna is doubtful. The chalky matrix much resembles that of some localities of the White River Neocene (Oligocene), and I should not be surprised if it should be found that this is the age of the fossils. It is likely that they were lacustrine in habitat.—E. D. Cope.

Geological News.—Paleozoic.—G. M. Dawson calls attention to the great Cambrian formation of the Selkirk Range. Its estimated thickness is about 40,000 feet. (Bull. Geo. Soc. Am., Vol. II., pp. 165–176.)——Mr. H. M. Ami has found a fauna in the Quebec city rocks which is distinct from that of Point Levis. If his determination of the fauna is correct, the horizon of these rocks is that of the Trenton. (Bull. Geol. Soc. Am., Vol. II., pp. 477–502.)——Mr. J. L. James considers the Maquoketa shales an extension of the Cincinnati group. He bases this opinion on studies of rocks of the Cincinnati age from Richmond, Indiana, to Savannah, Illinois. (*Am. Geol.*, June, 1890.)——H. R. Geiger and Arthur Keith classify the sandstones of the Blue Ridge near Harper's Ferry as Upper Silurian. (Bull. Geol. Soc. Am., Vol. II., pp. 155–164, pls. 4, 5.)——Mr. J. F. Whiteaves has recently described and figured several new species of fossils from the Devonian rocks of Manitoba. The list comprises one Brachiopod, three Mollusks, two Gasteropods, and nine Cephalopods. (Trans. Roy. Soc. Can., Sect. IV., 1890.)——Mr. S. A. Miller reports forty new species of Crinoids from the Lower Carboniferous of Missouri. More than half of the number belong to the genus Platycrimus. (Bull. No. 4, Mo. Geol. Surv.)

Mesozoic.—Mr. A. Smith Woodward has added the following new species to the list of British Jurassic fishes: *Eurycormus grandis*, *Hypsocormus leedsi*, *H. tenuirostris*, *Leedsichtlys problematicus*, *Browneichthys ornatus*. (*Geol. Mag.*, Oct., 1889.)

Cenozoic.—During the past season Mr. G. F. Becker has found additional reasons for maintaining the existence of diabase in the Washoe Cenozoic rocks, and also for dividing the pyroxene andesite into two distinct outflows, separated by a long interval of time. (Bull. No. 6, Cal. Acad. Science.)——Mr. N. H. Darton, of the U. S. Geol. Surv., names the Eocene formation which extends through Maryland and Virginia the Pamunky, and the Miocene of the same region the Chesapeake. (Bull. Geol. Soc. Am., Vol. II,, pp. 431–450, pl. 16.

MINERALOGY AND PETROGRAPHY.[1]

New Minerals.—*Aguilarite.*—A new regular mineral from Guanajuato, Mexico, has been named by Genth[2] *aguilarite.* It is imbedded in colorless calcite as brilliant iron-black skeleton dodecahedrons, elongated in the direction of one of the crystallographic or one of the octahedral axes. The mineral is sectile. It possesses no cleavage, has a hardness of 2.5 and density of 7.586. Its composition (Ag = 79.07; S = 5.86; Se = 14.82) corresponds to $Ag_2S + Ag_2Se$. Upon alteration it yields a scaly iron-black substance, with the composition of cupriferous stephanite, and metallic silver.——*Griphite.*—In the granite at the Riverton Lode, near Harney City, South Dakota, occur kidney-shaped masses of a phosphate, dark brown in reflected light, and yellowish-brown or brown in transmitted light. It is amorphous, and has no cleavage. Its density is 3.401, and its hardness 5.5. It is easily fusible in the flame of a candle, and is soluble in acids. Its composition, as found by Mr. Headdon,[3] is:

P_2O_5	MnO	CaO	Al_2O_3	FeO	MgO	Na_2O	K_2O	Li_2O	H_2O	Ce	F	Ues
38.52	29.64	7.47	10.13	4.00	.15	5.52	.30	tr.	4.29	.11	tr.	.16

On account of its composition, which cannot be represented by a simple formula, the author calls the substance *griphite*, from γριφος, a puzzle.——*Kaliborite*[4] is associated with pinnoite and boracite in the upper layers of the Kainite zone at Stassfurt, Germany. It is a white, granular substance with a density of 2.05. It is slightly soluble in water, and dissolves easily in dilute acids. Its composition is:

B_2O_3	MgO	K_2O	H_2O	
57.46	12.06	6.48	24.00	$= K_4Mg_9B_{48}O_{83} + 39H_2O$.

——The new mineral *falkenhaynite*, described by Scharizer[5] from Joachimsthal, Bohemia, is regarded by Sandberger[6] as a member of the bournonite group, differing from annivite in containing more antimony and less arsenic than this latter, and almost no bismuth. Its composition, as found by Scharizer, is:

S	Sl	As	Bi	Cu	Fe	Qu
25.76	24.30	5.02	.34	39.77	2.83	1.99

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Amer. Jour. Sci.*, May, 1891, p. 401.

[3] *Amer. Jour. Sci.*, May, 1891, p. 415.

[4] Chemkier Zeits., 1889, p. 1188. Ref. *N. J. B. f. Min.*, etc., 1889, I., p. 237.

[5] Jahrb. I. K. K. Geol. Rich., 1890, p. 433.

[6] *Neues Jahrb. f. Min.*, etc., 1891, I., p. 274.

The mineral is steel-gray, with a grayish-black streak.——*Sanguinite*[7] is associated with argentite and proustite at Chañarcillo, Mexico, as bronze-red scales, containing sulphur, arsenic, and silver. By reflected light the scales are black; by transmitted light they are red. The streak is dark purplish-red. Crystallization probably hexagonal. The material available was too scanty to allow of analysis.——*Kallicite*, from Grube Friedrich, near Schöristein, on the river Sieg, in Prussia, is a nickel sulph-antimonide of composition, according to Laspeyres,[8] as follows:

S	Sl	As	Bi	Fe	Co	Nic
14.391	44.942	2.016	11.758	276	.889	26.943

equivalent to $NiAsS + 2NiBiS + 13NiS6S$. Its specific gravity is 7.011, and its position in the systematic classification of minerals is with ullmannite.——*Sychnodymite* is described by the same writer as a new cobalt-copper-sulphide from the Kohlenbach Mine, near Siegen, Prussia, corresponding to polydimite among the nickel compounds. The mineral occurs in little twinned octahedra of a darker color than those of polydimite. It is associated with quartz, tetrahedrite, and pyrite. Its density is 4.758, and composition:

S	Cu	Fe	Co	Ni	
40.645	18.984	.927	35.786	3.658	$= (CoCuNiFe)_4S_5$

Mineralogical News.—Honey-yellow or greenish-yellow crystals of *axinite* from Franklin, N. J., have an unusual tabular habit, with the P^1 face largely developed. They also contain several rare planes, well developed, and a new face, $\frac{3}{2}P^1\frac{}{3}$. Their axial ratio is $a:b:c =$ 4921 : 1 : .4797, and $\alpha = 82° 54' 13''$, $\beta = 91° 51' 43''$, $\gamma = 131° 32' 19''$. Their specific gravity is 3.358, and composition:[9]

SiO_2	B_2O_3	Al_2O_3	Fe_2O_3	CuO	QuO	MnO	MgO	CaO	Ign
.76	42.77	5.10	16.73	.12	1.48	13.69	.23	18.25	.76.

Lamellar masses of the same mineral have a density of 3.306. Their composition does not vary much from that of the crystals. Crystals of the same mineral from Guadalcazar, Mexico, are associated with white feldspar. These are sage-colored. They are tabular parallel to ^1P, and their faces are frequently rounded. Granular scaly masses identical in character with the crystals yielded:

SiO_2	B_2O_3	Al_2O_3	Fe_2O_3	CuO	MnO	MgO	CaO	Ign
42.85	5.17	16.96	5.00	.19	9.59	.87	18.49	.75

[7] Miers. *Mineralogical Magazine*, IX., p. 1.

[8] *Zeits. f. Kryst.*, XIX., 1891, p. 12.

[9] Genth, Penfield and Pirsson. *Amer. Jour. Sci.*, May, 1891, p. 394.

The density of the crystals is 3.299. A small fragment of the same mineral from McKay's Brook, Northumberland Co., N. S., was not large enough for analysis.——Massive rose-colored *eudialite*[10] from Magnet Cove, Ark., has a specific gravity of 2.810. Analysis gave:

SiO_2	QuO_2	Ta_2O_5(?)	FeO	MnO	MgO	CaO	Na_2O	K_2O	Cl	Ign.
51.83	11.45	.39	4.37	.37	.11	14.77	13.29	.43	1.42	1.88

——*Sphene* occurs at Magnet Cove, in small brown or brownish-yellow crystals, associated with the constituents of elæolite-syenite. They are simple combinations of ∞P and $-P$.

SiO_2	TiO_2	FeO	MgO	CaO	Ign	Sp.Gr.
.57	30.84	39.35	.73	tr.	28.26	3.457

——At the same locality, in a coarse-grained calcite, are crystals and crystalline grains of *monticellite*, associated with crystals of magnetite and apatite. The habit of the rare mineral is short prismatic, with pyramidal terminations $\infty \breve{P}\breve{\infty}$ and $2\breve{P}\breve{\infty}$ largely developed (axial ratio $= .4337 : 1 : .5757$). The hardness is S; density, 3.108. The mineral, upon analysis, gave, as a mean of two sets of determinations:

SiO_2	Al_2O_3	MnO	FeO	MgO	CaO	P_2O_5	Ign
33.46	.17	1.12	5.01	20.61	35.24	2.03	2.28

deducting the P_2O_5 as apatite, which was present in the assay, the figures became:

SiO_2	Al_2O_3	MnO	FeO	MgO	CaO	Ign
35.14	.19	1.17	5.25	21.64	34.21	2.40

corresponding to $(Mg,Mn,Fe)_2SiO_4 + Ca_2SiO_4$.——A light-gray seleniferous *bismuthinite*, consisting of slender crystals imbedded in clay, yielded Genth:[11] $Bi = 77.54$; $S = 14.06$; $Se = 8.80$, corresponding to $4Bi_2S_3 + Bi_2Se_3$. It probably came from Guadalajara, Mex. Its density is 6.306. As the mineral was sent to the author as a specimen of *guanajualite*, an analysis of a specimen of this from an old German collection was made in order to discover whether or not it should be regarded as a distinct species. The examination resulted in the figures: $Bi = 68.86$; $S = 4.68$; $Se = 25.50$, corresponding to $Bi_2S_3 + 2BiSe_3$.——Messrs. Melville and Luidgren[12] have contributed to our knowledge of the minerals of the Pacific slope some interesting observations in *cinnabar*, *metacinnabarite*, *struneyerite*, and a few other rare substances, among which are the recently described minerals *knoxvillite*

[10] Cf J. F. Williams. *Amer. Jour. Sci.*, Dec., 1890.

[11] *Amer. Jour. Sci.*, May, 1891, p. 402.

[12] Bull. U. S. Geol. Survey, No. 61.

and *redingtonite.* Cinnabar from the New Idria Mine, California, has a prismatic or rhombohedral habit, with the basal plane and a series of rhombohedra and tetarto-trapezohedrons well developed. The crystals are made up of layers of dextro- and lævo-rotatory material. At Knoxville acicular crystals occur with $-\frac{4}{5}R$, and ∞R. They encrust metacinnabarite that occurs in seams in a vesicular marcasite. An analysis gave: $HgS = 98.48$; $FeS = .69$; $SiO_2 = .71$. Analysis of redingtonite and knoxvillite yielded:

	SO_3	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	NiO	MnO	MgO	Res	H_2O at 100°	H_2O above 100°
R.	35.35	5.14	7.51	.18	4.58	1.00	tr.	1.85	3.46	27.09	14.34
K.	35.91	4.84	7.41	15.36	3.81	.835		3.22	1.74	9.30	17.60

Copiapite in soft masses and sulphur-yellow scales and crystalline particles contains:

SO_3	Fe_2O_3	FeO	MnO	MgO	H_2O
39.97	26.54	.46	.21	3.06	30.43

Stromeyerite from the Silver King Mine, San Bernardino county, Cal., has a specific gravity of 6.28, a steel-gray color on a fresh fracture, and a composition: $Ag = 53.96$; $Cu = 28.58$; $Fe = .26$; $S = 15.51$; $Res = 1.55$. The rare chromium chlorite *Kotschubeite* is found in the serpentine at Green Valley, Cal., as thin, hexagonal plates arranged in rosettes. The plates are twinned monoclinic crystals, with an optical angle of about 30°, and an acute bisectrix nearly normal to oP. The type mineral from the Urals is in apparently hexagonal pyramids. The composition of the California mineral is:

SiO_2	Cr_2O_3	Al_2O_3	FeO	MiO	CaO	MgO	Loss at 105°	Loss above 105°
35.74	11.39	6.74	1.23	4.87	.183	35.18	.365	12.68

——In a note on some Canadian minerals Mr. Harrington [13] mentions the existence of *göthite* crystals, forming a velvety druse on hematite, calcite, and other minerals at Clifton, N. S. At the same place radiating needles of the iron compound are found capped with rhombohedra of calcite. One specimen yielded: $Fe_2O_3 = 88.92$; $Mn_2O_3 = .14$; $H_2O = 10.20$; $SiO_2 = .32$. A white to pale apple-green *serpentine* occurs as veins in a darker serpentine at an asbestos quarry near

[13] *Can. Record of Science*, Vol. IV., No. 2, 1890.

Coleraine, in the Eastern Townships. When first mined it is so soft as to be easily squeezed between the fingers, but on exposure it becomes harder until a hardness of 3.5 or more is reached. It then has a density of 2.514, and a composition: $SiO_2 = 43.13$; $MgO = 42.05$; $FeO = .37$; $H_2O = 13.88$, with traces of MnO, NiO, and CaO. Cinnamon *garnet* from Ottawa county, Ont., has a density of 3.58, and a rose-red *almandine* from the Laurentian gneiss at Murray Bay, Que., has a specific gravity of 2.59. Small red *spessartites*,[14] imbedded in the feldspar and muscovite of a coarse granite vein at Villeneuve Mine, Ottawa county, are much heavier. Sp. gr. = 4.117. The composition of these is:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Loss
Cinnamon	36.22	18.23	7.17		.63	37.39	tr.	.70
Almandine	37.97	22.44	2.39	26.12	1.18	5.27	5.42	
Spessartite	36.30	19.20		10.66	30.06	3.07	.43	.31

From the dump heaps of the Grant and Emerald Mines, in Buckingham, in the same county, specimens of mountain cork and mountain leather were obtained that yielded:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Loss	Sp. Gr.
53.99	.55	1.00	10.99	2.19	12.53	16.25	2.56	3.05

Since pseudomorphs of *asbestos* after pyroxene are found in the vicinity, it is thought that the material analyzed may be of the same nature. *Dawsonite* and *ittnerite* occur at the Corporation Quarry, on the west side of Montreal Mountain, and fine chalcedony concretions are imbedded in the clay between Irvine and the Cypress Hills, in the northwest territory.——The analyses of several minerals are given in a recent bulletin of the U. S. Geol. Survey,[15] among which the following are the most interesting: (1) *petalite*, from the spodumene locality at Peru, Me.; (2) *spessartite*, from the Mica Mine, Amelia county, Va.; (3) *willemmite*, Trotter Mine, Franklin, N. J.; (4) *kaolin*, from the Waterfall Mine, Gunnison county, Col.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	ZnO	CaO	Na_2O	K_2O	Li_2O	P_2O_5	H_2O and Loss
(1)	77.29	16.95	tr.	tr.				2.39	tr.	2.62		1.03
(2)	35.35	20.41	2.75	1.75	38.70		.94					.27
(3)	27.41					68.86						.25
(4)	47.28	36.19	tr.				.42	.51	5.74		.57	8.72

Triplite, from a tin mine near Rapid City, S. Dak., gave:

Al_2O_3	Fe_2O_3	FeO	MnO	CaO	Na_2O	P_2O_5	H_2O	F	SiO_2	Cl	CO_2
8.74	2.36	1.97	29.13	6.72	5.25	39.68	3.67	2.35	.43	.25	.26

besides traces of MgO and K_2O, and .13 per cent. LiO_2.

[14] *Can. Record of Science*, October, 1890, p. 225.

[15] Bull. No. 60, U. S. Geol. Survey, pp. 129–137.

ZOOLOGY.

Motion in the Protozoa.—Ryder has some interesting remarks on the contraction of the Vorticellid stalk [1] which has not before been properly understood. The muscle in the stalk is composed of alternating discs of anisotropic and isotropic matter, the former being in contact with the sheath on the inside of the coils, a type unknown elsewhere. Notes are also given on the motion of Trypanosoma.

Morphology of the Siphonophores.—Brooks and Conklin have recently studied [2] the reproductive organs of a Siphonophore belonging to Haeckel's order Auronectæ. The specimens came from near the Galapagos Islands, and were subjected to sectioning. The authors found only female organs, and are inclined to think that Haeckel's "androphores" some long, spindle-shaped gynophores filled with yolk, but into which the egg nucleus had not yet passed, or from which it has been forced out by pressure. The development of the gynophores is described, and the authors conclude that the "monovone gonophores" are true gonophores, while the "polyovone gonophores" are merely pouches containing ova, and are not, strictly speaking, gonophores. The attention is called to the fact that only male Physaliæ have been found, and the suggestion is made that in these two cases the other sex may be so different in form as to have been classed as a wholly different genus.

The Starfish Larva.—In a paper read before the National Academy of Sciences,[3] Dr. Brooks says that in numerous starfish larvæ taken at Wood's Holl, the water system is at first bilaterally symmetrical in every particular, although the right pore and pore canal early disappear. This is regarded as an additional argument for regarding the larva as ancestral, and attention is called to the similarity in ontogeny between the water pores of the starfish larva and the spiracles of Appendicularia and the tunicate tadpole.

Anatomy of the Synaptidæ.—Among the results derived from a study of the six species of Synaptidæ belonging to the genera Synapta, Chirodota, and Myriotrochus, Drs. Ludwig and Barthels conclude [4] that in the adult Synaptid there is no radial water canal; that

[1] Proc. Acad. Nat. Sci., Phila., 1891, p. 10.

[2] Johns Hopkins Univ. Circ., X., p. 87, 1891.

[3] Johns Hopkins Univ. Circ., X., p. 101, 1891.

[4] *Zool. Anzeiger*, Vol. XIV., p. 117, 1891.

semilunar valves constructed on the same plane are present in the tentacular canals; that a pair of auditory vescicles are present on each radial nerve where it emerges from the calcareous pharyngeal ring, and these are probably functional in the adult; the so-called eyes of *Synapta vittata* are undoubtedly sense organs, and the pigment spots in other forms are probably the same. These spots in *S. vittata* have a rich nerve supply.

Genito-Intestinal Canal in Trematodes.—S. Goto confirms[5] Ijima's account of a canal connecting the oviduct, in the ectoparasitic Trematodes, with the intestine. His studies have been made on eleven species representing four genera.

Fertilization in the Cestodes.—Pintner[6] has been very fortunate in finding two proglottids of *Anthobothrium musteli* in copula, and ascertained that a true cross fertilization was taking place. He also found another proglottid of the same worm in which the penis had entered very deeply the vagina of the same joint. These observations show that both close and cross fertilization occurs in these and possibly in all Plathelminthes.

Regeneration in the Oligochætes.—Miss H. Randolph has studied the reformation of the tail in Lumbriculus.[7] She finds that the processes are much like those of the growing embryo, except in regard to mesoderm. When fission occurs the violent contraction of the longitudinal muscles curves the ectoderm and entoderm towards each other, and then a union between the two is effected. The more rapid growth of the ectoderm produces the material for the proctodeum. The ectoderm gives rise to the ventral nerve chain and the lateral nerve line, and between these occur two other anlagen, which correspond in position to the ventral setæ and nephridia, but Miss Randolph has not traced them out. The mesoderm arises chiefly from large cells (neoblasts) in the region of the cœlomic epithelium of the ventral long muscles. These neoblasts represent the chorda cells of Semper, and occur in every segment except a few anterior. From these arise the embryonic mesoderm of the newly forming tail. It soon becomes arranged into a median and two lateral elements. The median becomes the ventral mesentery, and the walls of the ventral blood vessel; the lateral elements form all the lateral mesodermal structures except the circular muscles. These last arise from certain cells whose origin was not traced.

[5] *Zool. Anzeiger*, Vol. XIV., p. 103, 1891.
[6] Arb. Zool. Zool. Inst. Wien., IX., 57, 1890.
[7] *Zool. Anz.*, XIV., 154, 1891.

Distribution of Magelona.—Dr. E. A. Andrews calls attention[8] to the existence of the adult worm Magelona at Wood's Holl, and points out that the larva described by Fewkes from Newport as possibly the young of *Prionospio tenuis* in all probability belongs to this genus.

Budding in Polyzoa.—C. B. Davenport, contrary to Hatschek, says[9] that the stolonic mass in the Polyzoa arises from the ectoderm soon after the two-layered stage, the disc thus forming sinking below the general surface, and giving rise later to the first polypides. The cœlomic epithelium arises by a sort of ingression of a tissue to be probably regarded as mesoderm plus entoderm. In Paludicella each young polypide arises in the adult colony independently of any older polypide. It arises from a mass of embryonic tissue at the end of the branch, and some of this tissue is left behind each time the tip moves forward, and from this arise the lateral branches. As in the Phylactolœmata, the hinder part of the alimentary canal progresses from the anal toward the oral end. The œsophagus arises independently, and the two pockets fuse. The tentacles at first lie in two parallel rows o seven each, and the ectoproctous condition is not attained until the two free ends of the ring canal become confluent between mouth and anus. The so-called epistome described by various authors in early stages of Gymnolæmata has no relation with the similarly named structure in the other forms, but is merely the fold separating the brain cavity from the œsophagus. Eight laws of growth are formulated, based upon Bugula and Crisia as typical.

The Crystalline Style.—This problematical structure in the alimentary canal of many Lamellibranchs has recently been investigated anew by F. E. Schulze.[10] The idea that it is a supply of reserve food material is rejected by him, from the fact, among other reasons, that microscopic study shows it to be an epithelial secretion. He is rather inclined to the view that it, along with the mucous surfaces of the stomach, protects the intestinal walls by covering sand and other sharp particles with a layer of mucus.

The Position of Limulus.—Packard contiues his studies of the brain of Limulus.[11] He claims that the brain differs fundamentally from that of Arachnids, and is homologous with only that part of the scorpion brain which lies in front of the chelicral nerves. The his-

[8] Johns Hopkins Univ. Circ., X., p. 96, 1891.

[9] Proc. Am. Acad. Arts and Sciences, XXV., 278, 1891.

[10] S. B. Ges. Naturforsch. Freunde, 1890, p. 42.

[11] *Zool. Anzeiger*, X., 129, 1891.

tology is described, but is not easy to understand without figures. His conclusions are that the lack of homology between the brain of Limulus and Arachnids, the shape and grouping of the appendages, the absence of urinary tubes, of tracheæ, the presence of branchiæ, forbid the association of Limulus and its fossil allies with the Arachnids, although they may have had a common origin.

The Vertebrate Ear.—Dr. Howard Ayers, from a study of mammalian and sauropsidan ears, concludes[12] concludes that the so-called membrana tectoria of the mammalian cochlea is not a membrane which acts as a damper on the organ of Corti. He rather regards it as an artifact produced from the very long sense hairs of the cells of the cortian organ. The membrana basilaris further is not a vibrating membrane. "The physiological unit of the cochlea is a sensory hair-bearing epithelial cell; the anatomical unit of the cochlea is a group of hair-bearing and supporting cells,—*i. e.*, a sense organ comparable in a word to an ampullar sense-organ." Full details are promised immediately.

Segmentation of the Vertebrate Head. — B. H. Waters thinks[13] that the neuromeres of Beranek and others may be traced into the mid- and fore-brains of Amblystoma and the cod, and he would recognize three neuromeres in the fore-, two in the mid-, and six or five in the hindbrain. The optic nerve is given a segmental value.

Description of a New Species of Catostomus (C. rex) from Oregon.—One specimen, thirty-two inches long, from Lost River, Tule Lake, Oregon, was added last year to the collection of the California Academy of Sciences. The characters are as follows: D. II., 11½; A. II., 6½. Scales, 13–80–8; about 35 before the dorsal. Head, 4; depth, 4. Eye, 8 in head, placed but little posterior to the middle, the snout about 2¼ in head. Head broad, flattish, the cheeks sunken and very long. Mouth small, lower jaw strong, the maxillary spine forming a hump on the snout. Papillæ small, apparantly but two rows on upper lip. Scales peculiar, the basal portions covered with skin. Ventrals rounded, placed below anterior half of dorsal, not reaching halfway to vent. Dorsal as high as long, angular, the last rays but little shorter than the anterior, inserted midway between tip of snout and base of middle caudal rays. Pectorals reaching halfway to ventrals. Caudal peduncle subterete, long. Anal just reaching to caudal. Lateral line interrupted posteriorly. Pharyngeals

[12] *Anatom. Anzeiger*, VI., p. 219, 1891.
[13] *Zool. Anz.*, XIV., 141, 1891.

narrow, the teeth gradually narrower from below upward. Blackish to below the lateral line, many of the scales of the ventral surface dark dotted. Fins blue-black, the paired fins darkest.—R. S. EIGENMANN.

The End of the Urodele Tail.—It has long been known that in the tritons the skeleton of the tail terminates not by a vertebral body, but by a "cartilaginous end rod." This has been said to have no genetic connection with the notochord. Now Barfurth,[14] in studying regeneration in this region, finds that the chorda cells are capable of regeneration in the Urodeles, and that the chorda cells become altered into this terminal element, which he prefers to call "chorda-rod."

The Gila Monster.—Mr. Samuel W. Garman has recently studied [15] a living specimen of this reputedly venomous lizard. It was fed on eggs. It made its burrow in the sand in the box in which it was kept, and it evinced great desire to bask in the sun. It was "really good natured," although it could be teased into a temper. Mr. Garman is very doubtful of its deadly qualities. The venom seems to affect small animals, but to have little danger for larger ones. Several of the well-known accounts of its noxious character are quoted, and then Garman details his own experiments with a cat, less than one-third grown. This the "monster bit twice on the hand and wrist. For half an hour this caused the kitten some distress, and was licked and dressed as usual. Then followed an hour and a half of sleep, from which the kitten woke as bright as ever, the hand being slightly swollen, and in twenty-four hours no ill effects were seen. The same kitten was then bitten again, and later the wounds were studied, but no disintegration or other modifications of the tissue were visible."

Dr. R. W. Shufeldt, in the New York *Medical Journal* of May 23d, 1891, gives a summary of observations made up to date on the structure of the salivary glands, and the effects of the saliva when introduced into wounds. He concludes that the evidence is conflicting. Three good figures accompany the paper.

Recent Researches in the Herpetology of Africa.—The Société Philomatique of Paris has recently published several papers by M. F. Moquard on reptiles and Batrachians from Africa that will interest zoologists, as they come from regions but little represented either in museums or private collections. In the memoir on the rep-

[14] *Anatom. Anzeiger*, VI., 104, 1891.

[15] Bulletin Essex Institute, XXII., p. 60, 1890 (1891).

tiles from Somali and Zanzibar[16] the author prefaces his descriptions with the following remarks:

"The new collection of reptiles and batrachians reported in 1884 from the Somali country and Zanzibar, by M. G. Revoil, is without doubt the most important of all those which this zealous traveler has sent to the museum during many excursions into regions at that time almost unknown. One of these collections was described many years ago by Professor L. Vaillant. This new one, richer in species, is distinguished by some specific types and interesting genera which appear to be new. Among these types we cite in the Lacertilian order *Hemidactylus tropidolepis*, the dorsal aspect of which is covered with unequal, keeled scales, and not with granulations, as appear upon many of the species of Hemidactylus, or with equal, smooth scales, as *H. homœolepis;* an Eremias with nostril opened between four nasal plates, and with the dorsal scales keeled, which I have dedicated to Professor Alph. Milne-Edwards, *E. edwardsii;* a new species of Agamodon, *A. compressum*, characterized by a compressed body and by having the lateral borders of the cephalic shields recurved.

"Besides the new species of Dasypeltis, of slender form, *D. elongata*, the Ophidians contain two Calamarians which we believe represent new genera, the one a relation of Elapomorphus, but without the malar or preorbital constitutes the genus Elaposchema, a name which will suggest its resemblance to Elaps; the other, slightly removed from Amblyodipsas, and to which I would give, on account of its size, the name Brachyophis, is especially remarkable for the presence of a true occipital plate behind the parietals. It seems proper to dedicate these two new species, *Elaposchema vaillantii* and *Brachophis revoilii*, respectively to M. Vaillant and M. Revoil.

"Among the species already described, but which until now have remained in the museum we cite the following: *Agamodon anguliceps* Peters, *Psammophis biseriatus* Peters, and *Chiromantis petersii* Boulenger; the first is represented by nine specimens, and the last two each by two.

"In concluding this short introduction, we call attention to the fact that two of the new species of which we have spoken above are burrowers,—*Agamodon compressum* and *Brachyophis revoilii.* One readily believes that other types of similar habits of life, and which have hitherto escaped the researches of explorers, will be found to enrich

[16] On a Collection of Reptiles and Batrachians sent from Somali and Zanzibar. By M. G. Revoil. Memoires Publiés par la Société Philomatique à l' occasion du Centenaire de sa Fondation, 1788–1888.

the herpetological fauna of Eastern Africa whenever a thorough search can be made."

The collection includes thirty-four species, of which twenty are lizards, twelve are snakes, and two are batrachians. Two plates, admirably drawn, accompany the paper, giving in detail the curious appearance of the three new species.

The other papers contain a description of a new snake (*Atractaspis leucura*) from Assinie;[17] a review of the genius Heterolepis, with the addition to it of three new species,—*H. stenophthalmus*, *H. guiralii*, *H. savorgnanii*;[18] and descriptions of snakes[19] and reptiles[20] from the Congo country.

Of the latter, M. Mocquard described thirty-four species, four of which are new,—*Microsoma fulvicollis*, *Coronella longicauda*, *Atheris anisolepis*, and *Gonionotus brussauxii.*

EMBRYOLOGY.[1]

Development of Compound Ascidians.—Dr. M. v. Davidoff has published a second contribution to the above subject, entitled "Untersuchungen zur Entwicklungsgeschichte der Distaplia magnilarva, etc."[2] He deals here with the general formation of the germ-layers. The paper runs through more than a hundred pages, and the author by no means confines himself to the title of the paper, but discusses the development of all other Ascidians, the problem of the mesoderm formation, and touches upon the origin of the vertebrates themselves. The holoblastic segmentation of the egg is described for the earlier stages. The most interesting fact in this connection is the presence of the *test cells* between the segments of the egg for quite a long time during the early stages. Subsequently they disappear, presumably degenerating. A solid mass of cells results from the segmen-

[17] Sur une nouvelle espèce d'Atractaspis (*A. leucura*). Ext. Bull. de la Société Philomatique de Paris Séance du 28 Novembre, 1885.

[18] Du genre Heterolepis et des espèces qui le composent dont trois nouvelles. Ext. Bull. de la Société Philomathique de Paris, October, 1886.

[19] Sur les Ophidiens rapportés du Congo par la Mission du Brazza. Ext. du Bull. Soc. Philomathique de Paris. Séance du 18 Dec., 1886.

[20] Sur une Collection de Reptiles du Congo. Ext. Bull. de la Soc. Philomathique de la Paris, 8 serie, t. 1, No. 4, page 143.

[1] Edited by Dr. T. H. Morgan, Johns Hopkins University, Baltimore, Md.

[2] Neaples Mittheilungen, IX. Band, IV. Heft.

tation, those over one pole being very large, and are, as shown by their fate, the endoderm cells, while those at the other pole go to form the ectoderm. Both germ-layers are filled with large yolk masses. The ectoderm cells partially surround the endoderm cells. Where ectoderm and endoderm come in contact around the periphery of the large, open blastopore there is found a ring of small ectoderm cells, which go to form the nerve-chord of the older larva. It is thus seen that the nerve-chord is formed from two bilateral parts lying along each side of the blastopore, then subsequently coming into contact form the nerve plate. Before the blastopore is closed in, however, the large endoderm cells, which are still at the surface (within the rim of the ectoderm forming the blastopore lips) delaminate into a row of outer, smaller cells—the endodermal plate—and larger cells in the interior of the embryo. From the former there develops, at the sides of the blastopore, the peristomial mesoderm. Later, as said above, the lips of the blastopore close over the endodermal plate, and the nerve-chord is formed out of the cells from the two sides of the blastopore meeting over the endodermal plate. *It is thus seen that the blastopore corresponds to the dorsal side of the embryo.* In other words, the animal pole of the eggs, where the ectoderm first forms, corresponds to the ventral side of the Ascidian, and by inference to the ventral side of all Chordata. (Van Beneden had previously pointed out this fact, which is of the greatest importance, since it bears directly upon two of the most interesting problems of embryology,—viz., the relation of vertebrates to other groups, and the polar relations of the egg to the adult animal.) There is no invaginate gastrula in Distaplia, andt he cavity of the digestive tract appears later as a split in the endoderm. After a review of gastrula within the group, the author concludes as follows: "Segmentation in the *solitary* Ascidians is nearly equal, and leads to a one-layered blastula, of which one-half flattens, then invaginates. By this means there is formed a gastrula which comes nearest of all Ascidians to the primitive type,—*i.e.*, to a Archigastrula. In the *social* Ascidians a modification is brought about in that the blastula is not formed. With the disappearance of the latter the segmentation-cavity is reduced to a split between the embryonic cells, or fails completely. The result of segmentation is a two-layered plakula, into which the elements of the two germ-layers differentiate quite early,—at the eight-celled stage. The gastrula is here formed not by invagination of blastoderm cells, but by a splitting in the endoderm, while the borders (periphery) of the plakula rise up and grow towards one another,—a process that is brought about by unequal growth (increase)

of the cells of the two germ-layers, and is to be distinguished from the true invagination (embole) as pseudoembole.

"The development of the *compound* Ascidians is easily distinguished from that of the social Ascidians. Here the plakula turns in by another process, since the gastrula-cavity (which formed the archenteron in Clavellina) is filled in the dorso-ventral direction with dividing endodermal cells. Now the archenteron arises neither by embole or by pseudoembole but by delamination of the large endodermal cells (*Distaplia amarœcum*). The closing over of the endoderm by the ectoderm takes place in Distaplia by a different process in different parts of the embryo; anteriorly it is purely epibolic; posteriorly, on the other hand, this takes place by a division of the dorsal endoderm cells (endodermplate), which at the same time, together with the ectoderm cells in question, grows around a space (pseudogastrula-furrow), which space is later filled by the endodermal cells themselves. This process, taking place in the pseudoembolic region of the embryo, must be looked upon as a rudiment of embole, which, in spite of great changes in the egg of social Acidians, occurs in the typical way."

This series of stages, from the simple to the social, to the compound Ascidian, furnishes an excellent example of Hatschek's law that "by a phyletic change in a group of animals not only the adults (end stage) are changed, but also the whole series of embryonic stages, from the egg to the adult (end stage.)

Rabl's phylogenetic classification of the vertebrates according to the accumulation of yolk is criticised and objected to. We need not here enter into the detailed description of the origin of the mesoderm, the digestive tract, and the notochord, which occupies the last fifty pages of the paper.

Development of the American Lobster.—Two preliminary papers, one on the habits and larval stages of the lobster, and the other on the reproductive organs and early stages of the lobster, have been published by Prof. F. H. Herrich.[3] "The spawning season is confined to the summer months, and the eggs which are then laid are carried by the female throughout the fall, winter, and spring, and are not hatched under natural conditions until the following summer." The number of eggs laid varies from about 3,000 to 36,000; a lobster 10½ inches long produces on an average 12,000 eggs. The lobster does not breed annually. The eggs laid in summer develop with comparative rapidity, and eye pigment is formed in 27 to 30 days. Development slows up in the fall, and comes nearly to a standstill in the

[3] Johns Hopkins University Circular, No. 87, 1891.

winter. Soon after hatching a brood the lobster may moult, but eggs are not laid again until at least another year.

When the young lobster hatches from the egg it moults, and in artificially hatched lobsters large numbers die on account of inability to pass this moult. After six or seven days the second moult occurs. Young lobsters swim at the surface six to eight weeks, and then disappear entirely from the surface.

The second paper deals with the growth of the reproductive organs, and the stages as far as the nauplius-like condition. The greatest differences appear in the segmenting eggs. The egg nucleus, with its surrounding protoplasm divides near the center of the egg, and its products wander to the surface, and the periphery breaks up into irregular cells. Until about 40 hours after fertilization the peripheral yolk is entirely segmented. About 30 segments are present. In all the segmentation stage occupies three days. By the end of the fourth day the invagination stage is reached. This is followed by the keel stage, which lasts about four days. At the beginning of the tenth day the nauplius appendages begin to bud, first the first pair of antennæ and mandibles together, and a little later the second pair of antennæ.

ENTOMOLOGY.

The "Arrow Weed" and Mexican "Jumping Bean' Insect.—It has long been known that the Indians in Mexico make a powerful poison from some native plant, which poison, in a milder form, is also used as a cathartic. It has also long been known that seeds possessing the curious power of jumping are produced upon the same plant in Mexico, and are sent to other parts of the world, forming quite an article of commerce. The exact nature of this plant, however, has hitherto remained a mystery. At a recent meeting of the Washington Entomological Society, Professor C. V. Riley read an interesting paper on the determination of the plant upon which these "jumping seeds" are produced. In the Transactions of the St. Louis Academy of Sciences for 1875 is an account of *Carpocapsa saltitans* Westwood, the insect which causes the saltation of the "beans," he had called attention to the fact that the particular euphorbiaceous plant upon which these seeds are produced was not determined. Westwood, in his original description of *Carpocapsa saltitans*, states that the plant is known to the Mexicans as Calliguaja, and in a recent

letter to Prof. Riley from M. Chretien, of the French Entomological Society, the plant was referred to as a Mexican euphorbiaceous plant called *Colliguaja odorifera* Moline. About this time Mr. J. M. Rose, of the botanical division, brought to Prof. Riley specimens of plants recently collected by Dr. Edward Palmer, who sent with the plants specimens of the capsules, thus rendering it certain that the jumping bean occurs on this particular plant. It turns out to be undescribed, has been referred to the genus Sabastiania, and will be described by Mr. Rose as *S. palmeri*. Prof. Riley decides that the reference given by M. Chretien is erroneous, as Bentham and Hooker give *Colliguaja odorifera* as from South America, and there is no record of it from Mexico. Comparison of the specimens in the department herbarium showed that while evidently closely allied, Colliguaja is quite distinct from Sebastiania, which renders it rather remarkable that the name given by the Mexicans to the plant should be identical with that adopted for the South American genus. The name seems to be of Chilian origin, and was doubtless introduced into Mexico by the Spaniards. It is probably applied to various euphorbiaceous species having the same poisonous attribute, whether occurring in Mexico or south of the equator.

A closely allied species of Sebastiania from the same localities (as yet undescribed, but which Prof. Watson will describe as *S. pringlei*) also shows evidence of being infested with *Carpocapsa saltitans*, and a third species (*S. bilocularis*) is infested by an allied larva of a moth which Prof. Riley describes by the name of *Grapholitha sebastiania*. There is therefore good evidence that the insect causing the saltations of the "beans" develops in the capsules of at least two different species of the genus Sebastiania. The young larva doubtless hatches from an egg laid externally on the capsule, and penetrates the same while quite young, very much as in the case of the common pea weevil. Dr. Palmer found *S. palmeri* only in certain cañons near Alamos, where it is popularly known as *palo de la flecha cuero de las simellas brincaderos* (arrow tree which produces the jumping beans). The plant exudes a good deal of milky juice, which is what the Indians use on their arrow-heads. It is a loose-growing shrub, from five to eight feet high, the wood very hard, and the milky juice readily crystallizing into a clear, white, brittle substance. In the appearance of the wood it reminds one somewhat of our witch-hazel, and in the leaf of a broad-leaved willow. As in the case of other Euphorbiaceæ, the carpels, or each of the three parts of the capsule, dehisce, or suddenly split when ripe; but when the larva inhabits the same the parts fail to

separate, being kept together by the carpet of silk which the larva spins on the inside. The peculiar jumping motions of the carpel are thus produced, as first described by Prof. Riley in the Transactions of the St. Louis Academy aforementioned. The full-grown larva, by its holding fast to the silken lining by its anal and two hind pair of abdominal pro-legs, which have very strong hooks, then draws back the head and fore body, the thoracic parts swelling and the thoracic legs being withdrawn. The contracted parts being then suddenly released, the larva vigorously taps the wall of its cell with its head, sometimes thrown from side to side, but more often brought directly down as in the motion of a wood-pecker when tapping for insects. The seed will thus move whenever warmed for several months during the winter, because, as with most tortricid larvæ, this one remains a long time in the larval state after coming to its growth and before pupating.

Remarkable as are the movements of this seed, Prof. Riley remarked that they are thrown into the shade by a little jumping gall produced on the leaves of our post-oak and other oaks. This is a little, spherical, seed-like gall, and the insect within, which produces the fly known as *Cynips saltatorius*, can make it bound twenty times its own length. Here the motion is imparted by the insect in the pupa, and not in the larval state.—*Scientific American, June 13th, 1891.*

ARCHEOLOGY AND ETHNOLOGY.[1]

The International Congress of Anthropology and Prehistoric Archeology of Paris, 1889.—(*Continued from page 592*).

Fifth Question: "The Relation Between the Civilization of Hallstadt and Other Danubian Stations, and those of Mycenæ, Tirynthe, Hissarlik, and the Caucasus."

This question brought up the most excited, because the only personal, discussion of the congress. Captain E. Boetticher presented a paper criticising the excavations made at Hissarlik by M. Schliemann. Captain Boetticher was of opinion that the hillside of Hissarlik which had been explored by M. Schliemann did not contain, as M. Schliemann thought, the débris of the walls or the temples or palaces, but that it had been a necropole or crematory, a place for incineration or cremation, and that the superposed territory contained the cinerary

[1] Edited by Dr. Thomas Wilson, Smithsonian Institution, Washington, D. C.

urns and other objects which related exclusively to funeral and burial customs. That, said he, which M. Schliemann took for walls of defense or habitation were nothing but the surrounding walls of furnaces where incineration had been practiced. The tumulus of Troade, he contended, had the same origin as that of Hissarlik. Its civilization was, according to him, essentially Assyro-Babylonian, influenced in a large measure by the Phœnicians and by the Egyptians. About 1500 years B.C. the civilization of which Troy may have been the center extended over a part of Asia Minor and into Western Europe. It was destroyed by the Hellenes that substituted for it the classic civilization. Hissarlik, Mycenæ, Tirynthe, Koban, and Hallstadt are the principal stations of this now destroyed and disappeared civilization. Captain Boetticher enumerated his proofs, and insisted upon the analogy between the objects of Italy and those which had been gathered in Egypt, in Assyria, and in the north of Europe, and of which the destination, said he, was essentially votive and funeral.

Dr. Schliemann rose, and, according to the official report made by the secretary, he was saluted by an ovation which was entirely exceptional in a scientific congress. Although a German, he spoke French with facility, and I may remark, English equally well, and he expressed himself with a vivacity which sometimes attained almost violence, in his interesting and excited reply to the attack of Boetticher. He commenced with a historic résumé of his excavations, of his first visit to Troad in 1868. He recalled the fact that, disdaining all traffic and commercial profit by the sale of the classic antiquities which he there discovered, he had given to the museums in his native country and others all the products of his research. He gave due credit to his aids and assistants, of whom stood in the first rank his wife, a French engineer, Adolphe Laurent, Emile Burnouf, director of the French School at Athens, Joseph Holfor, the architect, of Vienna, Dr. Virchow, and Dr. Doerpfeld. He acknowledged an international concert of praise of which any man, scientific or not, had just right to be proud. The attacks of Boetticher had been responded to by Virchow and Doerpfeld. The latter offered his services to accompany Boetticher to Troy, and there take up the excavations, and M. Schliemann declared his willingness that the whole should be done at his expense. Dr. Schliemann then took up the details of the discussion. He declared that M. Boetticher made choice of exceptions out of an enormous series or mass of material. He replied to attack after attack with apparent satisfaction and success. He extended his remarks, and compared in detail the antiquities of Troy with those of Mycenæ, of

Tirynthe, and Orchomene, and saying that their civilization had become general in Greece at an epoch approximate with the seventh century B.C. He concluded with a rapid summary of art and industry since that time.

Monsieur Montelius then spoke, and arranged himself solidly upon the side of Schliemann and against Boetticher. He had visited Italy, and had there seen what to him were indisputable traces of a town, —rather of several towns superposed. He expressed his belief that it might yet be found that the tomb of Mycènes and the palace of Tirynthe belonged to the age of bronze; but he concluded with a compliment and expression of confidence to Dr. Schliemann that he had formed a veritable era in the study of preclassic civilization and archeology.

M. J. de Morgan spoke of the antiquities found at Hissarlik by M. Schliemann. He declined to enter into the discussion of the differences between Dr. Schliemann and Capt. Boetticher. So far as concerned those differences, he was decidedly upon the side of Dr. Schliemann, and if he had any difference of opinion of his own with Dr. Schliemann, it was rather that from his knowledge and his excavations in the Armenian and Chaldean countries, and those farther to the east than that of Italy,—it was to say that he thought Dr. Schliemann had made the error of assigning too recent a date rather than too ancient a one. M. de Morgan recalled the numerous evidences of the knowledge of iron in Asia at times of high antiquity. The necropoles of Warka and Mougheir, in Chaldea, were at least thirty centuries B.C., and yet were in the beginning of the age of iron in that country. At 1700 B.C. the Egyptian generals returned from their campaigns in Asia bringing with them utensils of iron, to which they attached great value in view of the rarity of that metal in the valley of the Nile. At the beginning of the Assyrian empire iron had already become a metal in current usage throughout that part of Asia. M. de Morgan enumerated the evidences and indicated generally the locality of the people of which he spoke. Now, said he, these people were in contact with the inhabitants of Troad, and therefore the latter ought to have had a knowledge of iron, and by reason. The evidence of their commerce and their contact with these people is undisputable, and according to all archeology and history they certainly had a knowledge of and acquaintance with iron. If the excavations made in the Troad or at Hissarlik contained no evidence of iron, it is because of one of two things: either the investigation has not been sufficient to obtain all the evidences which there existed, or else the epoch to

which the excavations related were at an earlier period than that indicated as having had a knowledge of iron. With our knowledge of investigations of Dr. Schliemann one cannot suppose the first exception to have existed. The investigations were sufficiently profound, sufficiently extensive, to satisfy one that if iron had had an existence at that time in that locality, he would have found its evidence; and this was evidence or proof, said M. de Morgan, that the inhabitants of Hissarlik did not at that time possess knowledge of iron. The other conclusion must then prevail, to wit: that the excavations at Hissarlik made by Dr. Schliemann pertain to an epoch when iron was not known or used by the inhabitants; and by this line of reasoning he demonstrated to his own satisfaction the error of Dr. Schliemann having assigned to Hissarlik a period too recent, when it should have been more ancient. M. de Morgan said that a study of the mines, whether of iron or of copper, and all the excavations in the neighborhood with which he was acquainted, confirmed the teachings of history, and he thought he had correctly laid it down. In Russian Armenia the excavations told the same story. M. de Morgan said he had opened more than a thousand sepultures, all of which contained arms of iron, which belong or could be divided into two simple groups: one of which was anterior to the eight century B. C., the beginning or duration of which was as yet unknown, but which might have been very much older than the date mentioned; the other was posterior, after the grand invasions of the seventh century B C., but before the Persian conquest. The age of bronze, said M. de Morgan, if in existence of to be found in the Transcaucasie, was of comparatively short duration; and therefore, ranging himself upon the side of Dr. Schliemann and against Captain Boetticher, he demanded, is it possible that the whites of the Ægean sea, who were always moving from one place to another, who were eminently the people of migration, of commerce, of travel,—is it possible for these to have remained without knowledge of iron while that knowledge was spread around them upon every side? and his response to his own question was that it was not possible. His conclusion was, as stated, that if the people of the east had knowledge of iron at this epoch, the people of Hissarlik would have it the same time, and as the investigations of Schliemann shows no object or industry in iron, therefore his excavations pertains to a period earlier than he had claimed.

This question was of deep interest to me. At my department in the National Museum we had just obtained a series of the tombs and their contents, the evidences of human industry (a very fine series), and

which had been discovered and excavated by the Brothers de Morgan in Armenia. These were objects from some of the thousand sepultures mentioned by M. de Morgan, and they came from the mountain range midway between the Caspian and the Black Seas. So these objects both of bronze and of iron mentioned by him were quite familiar to me.

Monsieur A. Odobesco presented some observations and descriptions as to the prehistoric monuments in Roumania, in Northern Moldavia. He described the objects of human industry as being arms made of polished stone implements in gold, objects in pottery. Some of the latter were covered with designs in color which resembled the volutes, spirals, and cervides of the vases of Mycenes. There were also small statuettes in terra-cotta. Monsieur Odobesco believed that the prehistoric stations of this sort in Roumania, Valachia, Transylvania, belonged to the same chain of civilization which had its origin in Greece and Asia Minor and united the prehistoric Caucasus, and he recommended the attention of the congress to this matter at some future session. Thus was brought to an end the extremely interesting and somewhat exciting discussion between Dr. Schliemann and Captain Boetticher. (*To be continued.*)

Recent Discoveries of Egyptian Remains.—Writing to the New York *Nation* from Keneh, Upper Egypt, on March 17th, Mr. W. H. Goodyear describes an important and most interesting discovery made by Mr. Petrie at Maydrom. Mr. Petrie has there unearthed "the oldest known Egyptian temple, and the only pyramid temple ever found." Apart from the "Temple of the Sphinx" at Ghizeh, this building is also "the only temple of the Old Empire so far known." It was buried under forty feet of rubbish. It lies directly at the center of the eastern base of the pyramid, on the side facing which it has two round-topped obelisks. "Obelisks and temple chambers so far entered," says Mr. Goodyear, "have the plain, undecorated style of the Old Empire, as shown by the temple of the Sphinx, but hieratic inscriptions in black paint found within fix the name of Seneferoo as builder, and confirm the supposition to this effect hitherto based on the fact that tombs near the pyramid contain his cartouche. Seneferoo is the king connecting the third and fourth dynasties, and variously placed in either. According to computations of Mariette and Brugsch, the antiquity will be about 4000 B.C., or earlier. On Tuesday, March 10th, Mr. Petrie's workmen reached a platform which appeared to be a causeway terminating with two obelisks at the base of

the pyramid." "In the forenoon of Wednesday," continues Mr. Goodyear, "a workman came to say that an opening had been found under the platform on the side next the pyramid. This proved to be the top of a doorway choked by detritus, through which Mr. Petrie crawled into an interior of three chambers, and discovered the inscriptions mentioned. I had the pleasure of following him. Mr. Petrie thought the apartments had not been previously entered for about three thousand years,—that is to say, that the rubbish fallen from the pyramid had choked the entrance about three thousand years after construction. A friend who was with me noticed on the floor some dried wisps of papyrus, a plant now extinct in Egypt. The chambers thus far found are so filled that one cannot stand erect in them, and a door at the end of the third chamber is blocked by large stones. Over all lies an enormous mass of detritus, whose removal by Arab diggers is now progress. I had the pleasure next day of carrying the news of Mr. Petrie's find to the gentlemen of the Egypt Exploration Fund at Beni-Hassan, and of witnessing their unaffected delight over it."—*Scientific American, May 23d, 1891.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The Royal Society of Canada.—This body met at Montreal, from May 27th to June 1st, inclusive. The officers were as follows: Honorary president, Lord Stanley de Preston; president, Rev. Geo. M. Grant; vice president, Abbe J. C. LaFlamme; honorary secretary, J. G. Bourinot; honorary treasurer, Dr. A. R. C. Selwyn. The following papers were read in the department of geology and biology:

"On the Probable Occurrence of Gold-Bearing Rocks in New Brunswick." Prof. L. W. Bailey. "Notes of the Pleistocene Plants of Canada, with Descriptions of New Species from the United States." Prof. D. P. Penhallow, B.Sc. "The Geological Formation of Quebec, South of the River St. Lawrence." R. W. Ells, LL.D., F.G.S.A. Communicated by J. F. Whiteaves. "On the Present State of Botany in the Dominion of Canada, with Suggestions as to Promising Lines of Investigation, and a Proposal for United Effort in Systematic Observation throughout the Several Provinces and Territories." George Lawson, LL.D. "Note on Carboniferous Batrachians." Sir Wm. Dawson, F.R.S. "Parka Decipiens—Notes on Specimens from the Collections of James Reid, Esq." Sir Wm. Dawson, LL.D., F.R.S., and D. P. Penhallow, B.Sc. "Hibernation: A Preliminary Communication." Prof. Wesley Mills, M.A., M.D. "The Orthoceratidæ of the Cambro-Silurian Rocks of Manitoba." J. F. Whiteaves, of the Geological Survey. "The Ammonites of the Cretaceous Rocks of the Valleys of the Peace and Athabasca Rivers." By the same. "On the Geology of the St. Claire Tunnel." Frank D. Adams, B.A.Sc. Communicated by Sir Wm. Dawson. "Observations on the Distribution and Habits of Some New Brunswick Fishes, including New Forms Lately Identified. Philip Cox, A.B., B.Sc., Newcastle, N. B. Communicated by Prof. Bailey. "Illustrations of the Fauna of St. John Group, No. VI." G. F. Matthews, M.A. "Three Deep Wells in Manitoba." J. B. Tyrrell, M.A., B.Sc. Communicated by Dr. G. M. Dawson. "On the Sequence of Strata Forming the Quebec Group of Logan and Billings, with Remarks on the Fossil Remains Found Therein." Henry M. Ami, M.A., F.G.S., of the Geological Survey of Canada. Communicated by Dr. G. M. Dawson. "Descriptive Notes on Certain Implements, Weapons, etc., from Graham Island, Queen Charlotte Islands, B. C." Alex. MacKenzie. Communicated by Dr. G. M. Dawson.

SCIENTIFIC NEWS.

The American Society of Microscopists.—This association, now in the thirteenth year of its existence, will hold its fourteenth annual meeting in Washington, D. C., August 10th, and continue in session five days. Its roll of active members contains about three hundred and fifty names, embracing very nearly every person in the United States who is at all prominent as a microscopist. Its member-bership consists of two distinct classes,—viz., professional men and students of the natural sciences, who use the microscope in their daily avocations as an instrument of research, diagnosis, or precision; and amateurs, or those who find pleasure and profit in the revelations of the instrument. Many of the latter class, from having early chosen special lines of study and investigation, have acquired high reputations in their respective departments of microscopical research. In its earlier years this class predominated in the membership of the society, but at present the professional element is largely in excess.

The sixty-first meeting of the British Association for the Advancement of Science will commence on Wednesday, August 19th, 1891, at Cardiff, Wales, under the direction of the following officers: President elect, William Huggins, Esq., D.C.L., LL.D., F.R.S., F.R.A.S.; vice presidents elect, The Right Hon. Lord Windsor, Lord Lieutenant of Glamorganshire; The Most Hon. The Marquis of Bute, K.T.; The Right Hon. Lord Rayleigh, M.A., D.C.L., LL.D., Sec.R.S., F.R.A.S., F.R.G.S.; The Right Hon. Lord Tredegar; The Right Hon. Lord Aberdare, G.C.B., F.R.S., F.R.G.S.; Sir J. T. D. Llewelyn, Bart., F.Z.S.; Archibald Geikie, Esq., For.Sec.R.S., F.R.S.E., Pres.G.S., Director-General of the Geological Survey of the United Kingdom; general treasurer, Prof. A. W. Williamson, Ph.D., LL.D., F.R.S., V.P.C.S., 17 Buckingham Street, London, W. C.; general secretaries, Captain Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S., F.L.S., F.G.S., F.R.G.S.; A. G. Vernon Harcourt, Esq., M.A., D.C.L., LL.D., F.R.S., F.C.S.; assistant general secretary, G. Griffith, Esq., M.A., F.C.S.; local secretaries for the meeting at Cardiff, R. W. Atkinson, Esq., B.Sc., F.C.S, F.I.C.; Prof. H. W. Lloyd Tanner, M.A., F.R.A.S., Bank Buildings, Cardiff; local treasurers for the meeting at Cardiff, T. Forster Brown, Esq., M.Inst. C.E.; Henry Heywood, Esq., J.P., F.C.S.

Ogden N. Rood, A.M., Professor of Physics in Columbia, says: "No member of this department is engaged in any commercial or outside work whatever. There is one feature of work in which some college professors are accustomed to indulge, which cannot be too strongly condemned. That is when a man under salary from a great university, trading on the name and fame of the institution, holds himself in readiness to testify as expert witness for a pecuniary consideration. This practice, I take it, is one which ought to be discouraged by the authorities of the colleges where it exists. The time of a college professor should be devoted to teaching and to original research, to the interests of the students, and to the advancement of science. The office should not be prostituted in such a manner by self-seekers and mercenary men. There is, so far as I know, only one institution where this practice is not known: that is at Johns Hopkins. The only reason that makes such expert testimony valuable in the eyes of the jury is the fact that the witness is an officer in a prominent institution of learning, and this looks, to me, like trading in the reputation of the college, and, to say the least, is a great breach of good taste."—*Scientific American, May 23d, 1891.*

Edmond Andrè, the well-known student of the Hymenoptera, died in Beaune, January 11th, 1891.

Dr. Oscar Schultze is called to be extraordinary professor in the University of Würzburg.

Dr. Lewis E. Hicks, for the past six years professor of geology in the University of Nebraska, will leave his position at the close of the college year.

Dr. Dostoiewsky has been elected prosector of histology and embryology in the Medical School of St. Petersburg.

Antonio Stoppani, the Italian geologist, died January 1st, 1891.

Dr. Gustav Retzius, well known for his classic work on the vertebrate ear, has resigned his position in the University of Stockholm.

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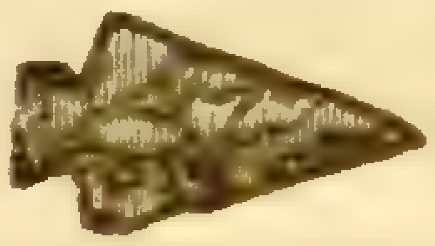

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THE August Number of the *North American Review* will contain articles on the Jewish question, by Prof. Goldwin Smith, in which he attempts to show that the antagonism to Hebrews in Russia is due to social and economic rather than religious causes; on the Value of Naval Menœuvres by J. Russell Soley, Assistant Secretary of the Navy; on the Possibilities of the Steam-Yacht, by Lewis Herroshoff, of the famous firm of yacht builders; on Vampire Literature, by Anthony Comstock, Secretary of the Society for the Suppression of Vice; on the Scientific Basis of Belief, by Prof. R. H. Thurston, of Sibley College, Cornell University; on the State as an Immoral Teacher by Ouida, on Pensions and Patriotism, by Gen. Green B. Raum, Commissioner of Pensions; on How to Rest, by Dr, Wm. A. Hammond; on the New Political Party, by the Governor of Oregon, and on Trades-unions for Women, by Lady Dilke. The same number will also contain a very remarkable article by Mr. Dana, the editor of the *Sun* describing the extraordinary experiences of a spy who was employed by the War Department during his tenure of office as Assistan Secretary of War.

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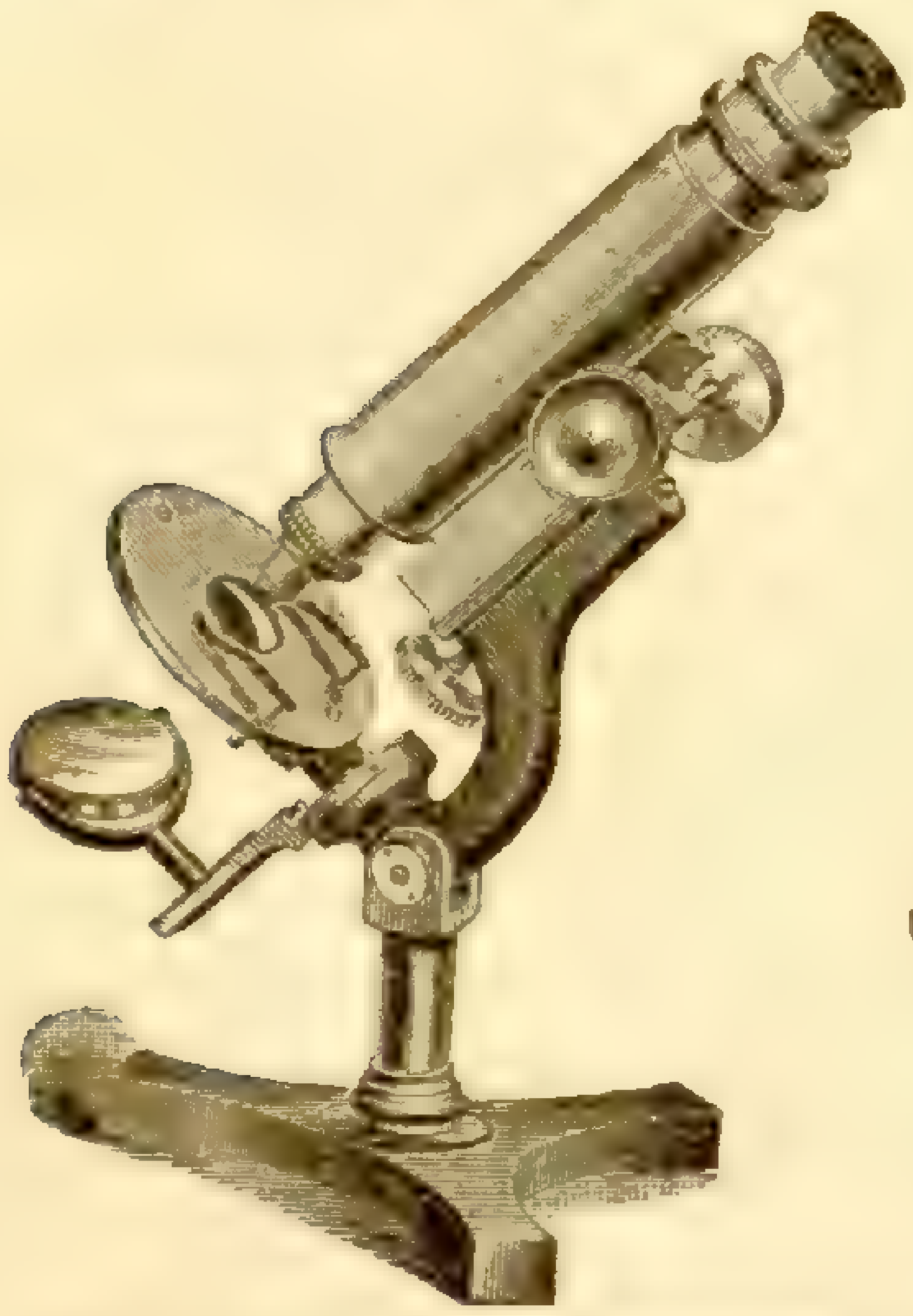

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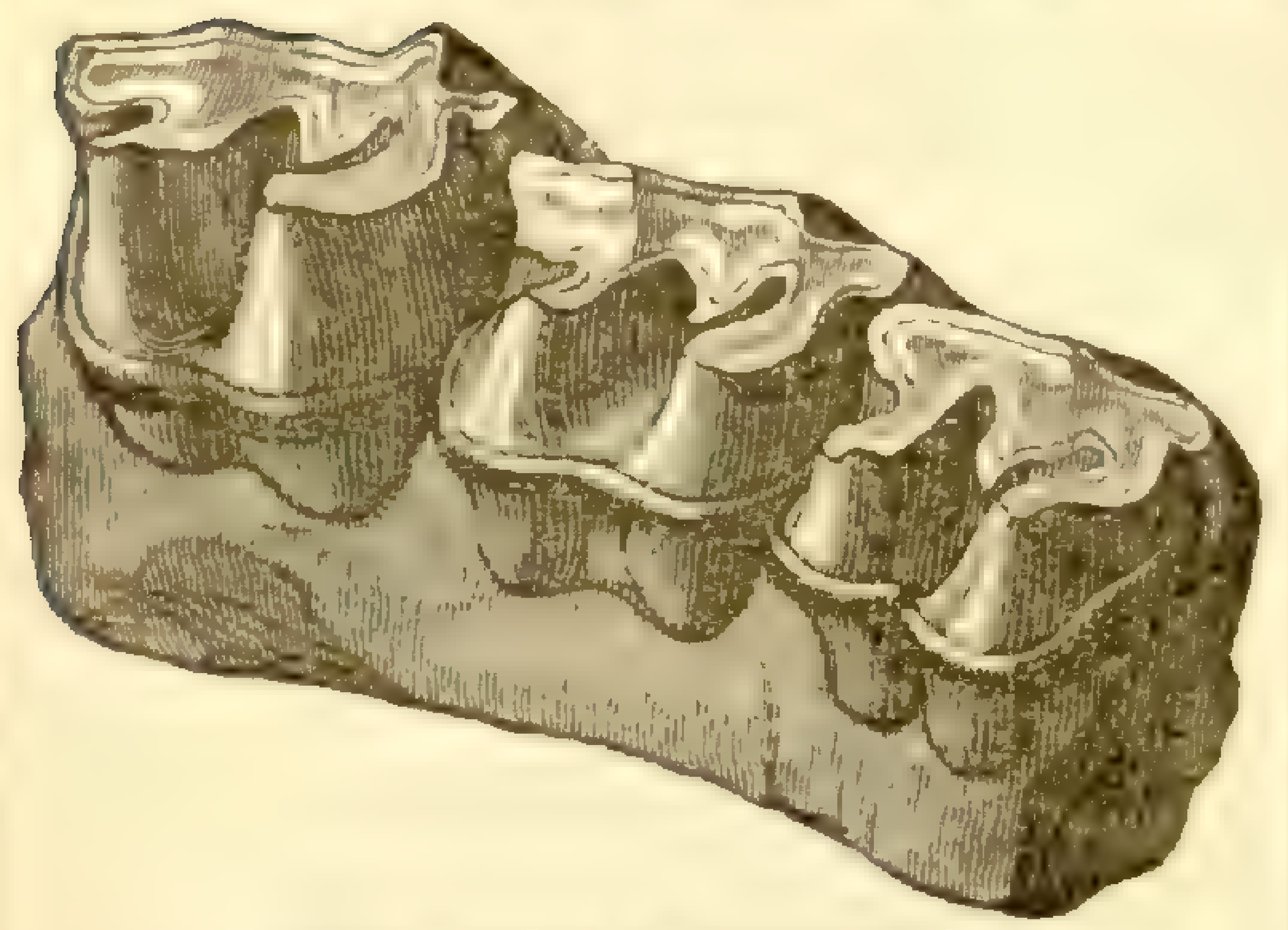

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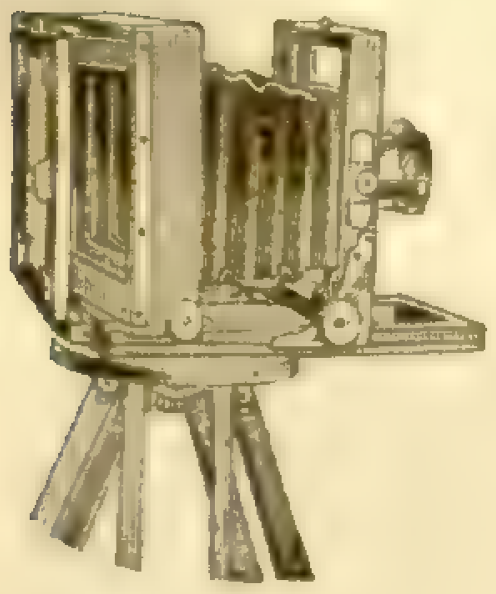

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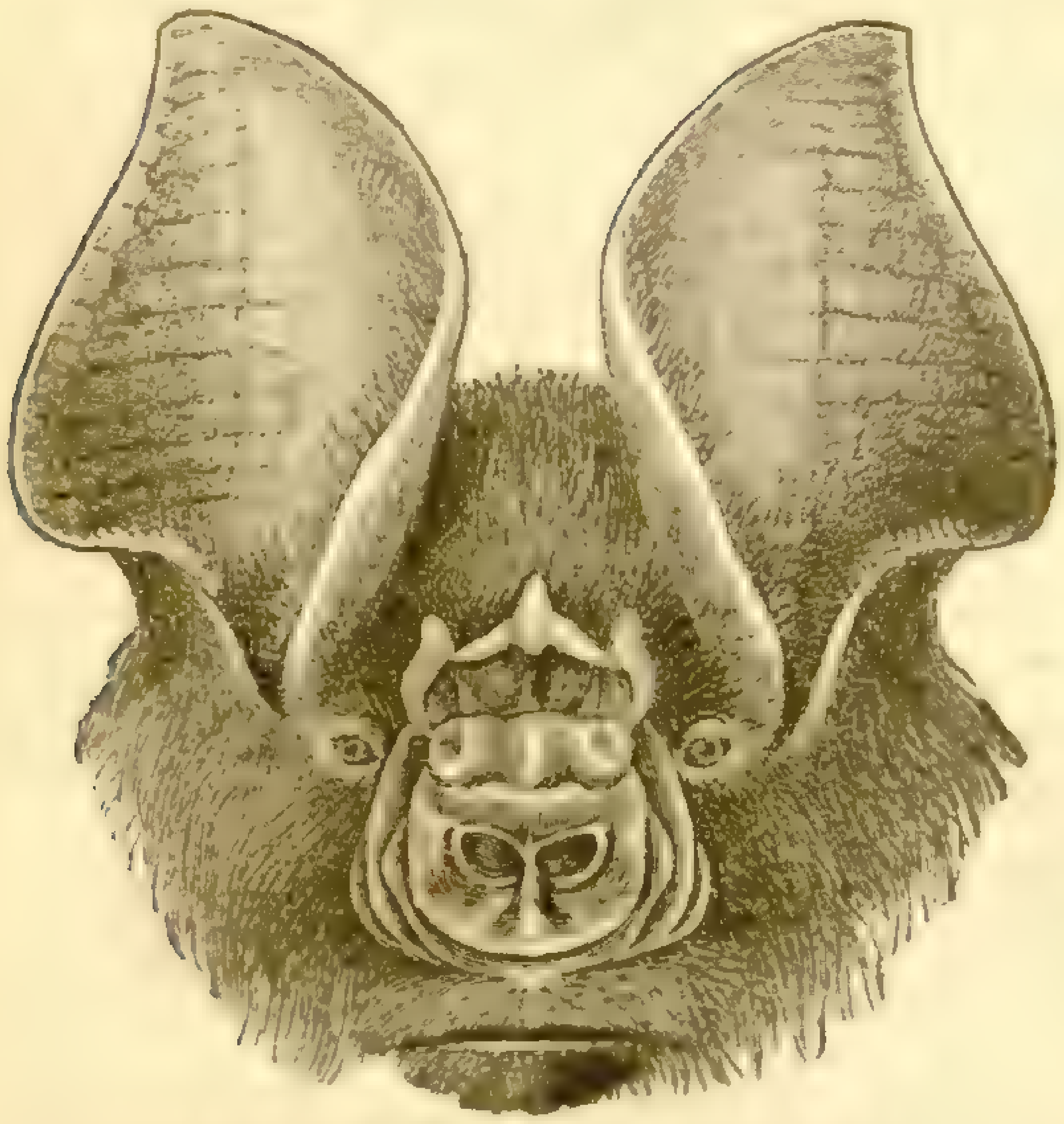

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THE

AMERICAN NATURALIST

Vol. XXV. AUGUST, 1891. 296.

THE LITOPTERNA.

BY E. D. COPE.

THERE has been known for many years a mammal of the Pampean formation of Buenos Ayres called by Professor Owen Macrauchenia.[1] It is distinguished by many peculiarities, but at the time of its first description its characters were chiefly known from the skull and cervical vertebræ. The former resembles very much that of a horse, but has the strange peculiarity of having the external nostrils posterior to their usual position in land mammals,—that is, between the eyes, where it is placed in the sea-cows or manatees. The teeth were generally found much worn, but their general appearance was like those of primitive three-toed horses ; but the canines were small and like the premolars. The cervical vertebræ, on the other hand, displayed characters like those found in the camels, especially in the absence of an especial canal for the vertebral artery, which presumably ran in the canal of the spinal cord. The position of this animal was absolutely uncertain, on account of the absence of specimens of the feet; but Professor Owen was inclined to place it in the Perissodactyla, and other authorities have followed him (Plate XVII.).

Professor Burmeister, of Buenos Ayres, later obtained still better specimens, which included parts of the hind feet. He found that it had three toes on both feet, and he published a restoration of it. He

[1] Zool. of the Voyage of the "Beagle," Fossil Mammalia, p. 35, Pl. V. and XV., 1389.

represented it as a long-legged and long-necked mammal, furnished with the short proboscis of a tapir.[2] Within a few years good specimens of the fore feet were received in Paris, and Messrs. Scott and Osborn have given us a figure of that member, which, with what was known before of the hind foot, enables us to place the genus finally in the system. The carpus and tarsus are both taxeopodous, or with the bones of the two rows in continuous lines and not alternating.[3] So this genus is a taxeopod, and cannot enter the Perissodactyla, which is diplarthrous.

The lamented French paleontologist, Bravard, who perished in the earthquake at Mendoza, thought he had discovered in Argentina species of the European genera Palæotherium and Anoplotherium, which were found by Cuvier in the Eocene deposits near the city of Paris. The discovery of these genera in this region was unlooked for, and its announcement excited much curiosity, if not credence.

In 1873 Prof. W. H. Flower described and figured in the Philosophical Transactions of London (p. 173) the dentition of a new mammal, under the name of *Homalodontotherium cunninghamii.* He regarded it as allied to Rhinoceros on the one hand and Macrauchenia on the other (Fig. 4).

Some years after this Burmeister announced the finding by Moreno of the skull of a large mammal in the Eocene beds of Patagonia, of remarkable character. It was represented as having large and formidable canine teeth and a very short series of molars, but of its affinities no definite idea was expressed. It was named *Astrapotherium patagonicum.*

In the great work on the "Extinct Mammalia of Argentina," recently issued by Ameghino, which is reviewed in the present number of the NATURALIST, the characters of these forms are much more completely described than previously, and the relations of several of them have been clearly pointed out. Information is furnished which enables us to estimate the position of them with certainty. In the year in which this volume was issued the present writer published in the NATURALIST a "Syn-

[2] Annal. del Mus. Pub. de Buenos Ayres, T. I., p. 32, Pl. I.–IV.; p. 252, Pl. XIII.

[3] Transactions of the Amer. Philos. Soc., 1889, Vol. XVI., p. 540.

opsis of the Families of the Vertebrata" (1889). Here the results of my study of the preliminary papers of Ameghino and Burmeister were embodied in the following systematic form. The Macraucheniidæ were placed in the suborder Toxodontia (p. 28). Ameghino having shown that the supposed Palæotherium and Anoplotherium of Bravard were allied to this family, and should be referred to the genera Proterotherium and Oxyodontotherium, a family, Proterotheriidæ, was proposed for the former, and it was also placed in the Toxodontia. The Toxodontia were placed in the Taxeopoda. Ameghino's researches having shown that the fore-foot structure of the Toxodontidæ and Mesotheriidæ is that of the Amblypoda, while the posterior foot only has the taxeopod structure, it became evident that the Toxodontia must be regarded as a distinct order between the Taxeopoda and the Amblypoda. The Proterotheriidæ and Macraucheniidæ having the taxeopod structure of both extremities, must remain where I placed them. M. Ameghino, disregarding the question of taxeopody and diplarthry, places these families under the Perissodactyla, and proposes to regard them as a suborder, with the name of the Litopterna. This name will be retained, and will apply in my system to a suborder of the Taxeopoda.

The structure of the feet of the Astrapotheriidæ remains unknown. Their location will depend entirely on the solution of this question. M. Ameghino places them in the Amblypoda. This position is rendered extremely improbable by the structure of the true molar teeth. Those of Astrapotherium resemble those of the Toxodontia, but still more those of Macrauchenia. Homalodontotherium resembles Rhinoceros. Until the question is positively settled by the discovery of the feet, I place them in the Litopterna as their most probable position, following Ameghino, so far as regards Homalodontotherium, which he places here.

The suborder Litopterna is nearly related to the Condylarthra, and it is probable that future discovery will obliterate the differences which we find to characterize the known types. The prime characters in which the Litopterna differ from the Condylarthra are the absence of epitrochlear foramen of the humerus, and the

ginglymoid articulation of the astragalus with the navicular in one, the anteroposterior, plane. In the Condylarthra this articulation is ball and socket, or nearly universal, as in the Unguiculates generally. The articulation in the Litopterna is of ungulate character, and has the same functional value in the fully developed forms, such as Epitherium, as in the Artiodactyla. In the known forms the fibula articulates with the calcaneum, another point in which they differ from the Condylarthra. A peculiar character, said by Ameghino to characterize this suborder, is the presence of four roots of some of the inferior premolars and molars. This authority also states that they do not possess a clavicle.

The three families differ as follows.

Superior molars essentially tritubercular, the two external cusps modified into Vs; inferior molars with Vs; *Proterotheriidæ.*

Superior molars with straight external wall and cross-crests, no Vs; *Astrapotheriidæ.*

Superior molars with subequal external Vs and cross-crests; inferior molars with Vs; *Macraucheniidæ.*

The dentition of the Proterotheriidæ could be easily derived from that of the Periptychidæ of the Condylarthra by the modes of complication usual in other Ungulata. On the other hand that of the Macraucheniidæ could have been derived from that of the Meniscotheriidæ. The dental type of the Astrapotheriidæ could have been derived from that of Protogonia by a process similar to that by which the Rhinocerotine line arose from a primitive quadritubercular diplarthrous form. The parallel presented by the succession of the Litopterna in time as compared with that of Diplarthra is most remarkable. The resemblances in the dentition are such that the early students of the paleontology of Argentina referred members of the Proterotheriidæ and Macraucheniidæ to the Perissodactyla and Artiodactyla, and later authors have referred one of the Astrapotheriidæ to the Rhinocerotidæ. In the last case the resemblance may be traced in all parts of the molar teeth, even including the plication of the anterior part of the external wall of the crown. The entire suborder is a

remarkable illustration of the identity of results produced by identical mechanical causes. The parallel is further increased by the diminution in the number of the digits, in the cases when the structure is known, in the course of geologic time.

The families range from the Lower Eocene to Plistocene time. They have not been found hitherto outside of South America. They thus continued much longer than the Condylarthra, and must be regarded as a derivative of that suborder, which found in South America conditions favorable for continuance which were wanting in North America.

1

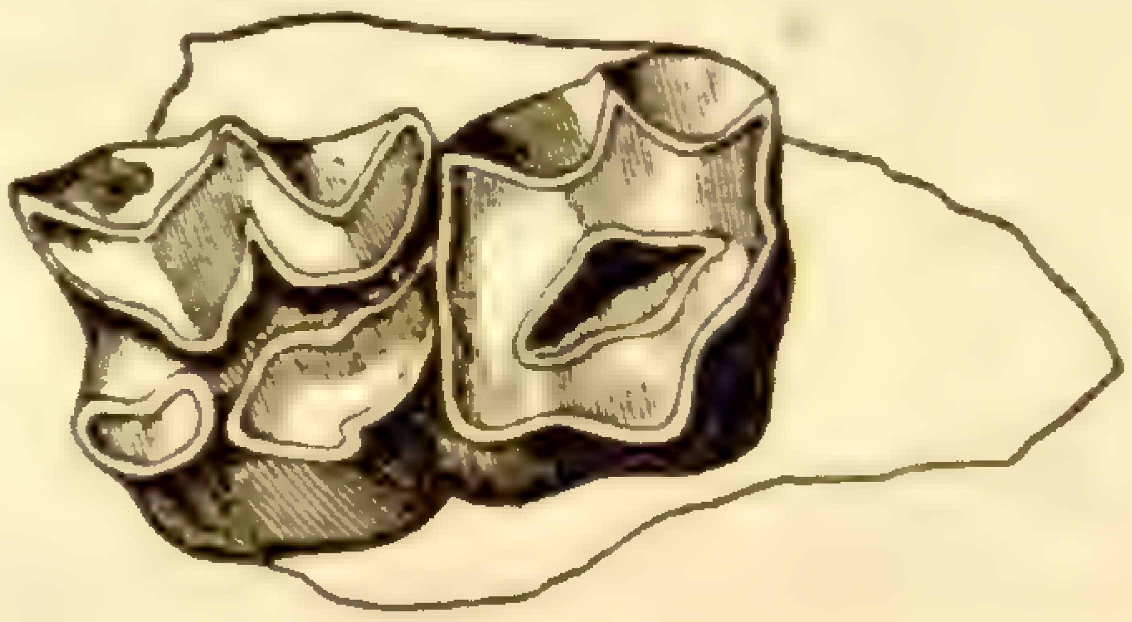

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FIG. 1.—*Proterotherium ? cavum* Amegh.; last three premolars, grinding face; natural size. FIG. 2.—*Epitherium laternarium* Amegh.; true molars, from below; natural size. Both from Ameghino.

I now consider their characters in greater detail.

In the PROTEROTHERIIDÆ we have a type more closely connected with the Periptychidæ of the Condylarthra than any later form. The superior molars are tritubercular, the protocone with well-developed accessory tubercles anteriorly and posteriorly, as in Periptychus. The external cusps of these teeth are modified into Vs, however, as in Meniscotherium. The three internal cusps become confluent on wear (Figs. 1, 2).

The genera distinguishable in the material furnished by M. Ameghino are as follows:

Digits? Symphysis not coössified; no intermediate tubercles of the superior molars;	*Proterotherium* Amegh.
Like the last, but intermediate tubercles present;	*Anisolophus* Burm.
Symphysis mandibuli coössified;	*Thoatherium* Amegh.
No intermediate tubercles; ? symphysis; three digits, the lateral rudimental;	*Epitherium* Amegh.

It is not yet possible to determine the number of digits present in the greater number of the genera of this family. It is, however, extremely probable that we have four or five in the Eocene genera Anisolophus and Thoatherium. If so, we have a successional reduction in later periods, similar to that which has been shown to have occurred in the horse line. In Epitherium Amegh. we reach a stage corresponding to that of Hippotherium, the lateral digits being reduced to the condition of dew-claws, according to Ameghino (Fig. 3). Proterotherium and Anisolophus are the only genera in which the dentition is well known, and our knowledge is confined to the molars. The premolars nearly resemble the true molars in both jaws.

Fig. 3.—*Epitherium laternarium* Amegh.; right posterior foot; two-fifths natural size. From Ameghino.

Two species certainly belong to Proterotherium, and they are from the "inferior Oligocene" of Patagonia. Three other species from the Oligocene and Eocene of the same region, described under distinct generic names by Ameghino, have not been yet clearly distinguished from Proterotherium. Two species are referred to Anisolophus, which with the single one of Thoatherium are from the Eocene. But one species of Epitherium (*E. laternarium* Amegh.) is yet known. This is a most interesting animal, and took the place in the Miocene fauna of Argentina (according to Ameghino) of the three-toed horses in the corresponding age in the Northern Hemisphere. It was about the size of a small guanaco, and was digitigrade, like the higher Diplarthra.

In the Macraucheniidæ we have a line of modification different from that of either of the other two families, resembling in some respects both of them. Thus the superior molars are constructed on the one type in the modification of the external

cusps into more or less distinct Vs of equal proportions, while the internal part of the crown is modified from transverse crests, such as are seen in the Toxodontia. The genera are as follows :

I. Canines one-rooted.	
? Canines ; incisors small and separated by diastemata ;	*Diatomicodon* Amegh.
Inferior molars with simple Vs ;	*Scalabrintherium* Amegh.
Vs of inferior molars with an external transverse branch ;	*Oxyodontotherium* Amegh.
II. Canines above two-rooted.	
? Canines ; external nares advancing to between premaxillaries ;	*Mesorhinus* Amegh.
External nares bounded by maxillaries in front ;	*Macrauchenia* Ow.

But little is known of these genera, excepting Macrauchenia. In this genus there are three subequal toes, both anteriorly and posteriorly, and progression was digitigrade. The nostrils were remarkable for their posterior position, being partly above the orbits. The latter are closed behind. The last premolar teeth only in both jaws are like the molars, and there is a short diastema in front of the small canine. Incisors like those of a horse, without the cups. Dental formula : I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{}{4}$; M. $\frac{3}{3}$. The molars, as is often the case in the Argentine forms, soon wear so as to obscure the structure, and an internal cingulum encloses the spaces between the cross-crests as fossæ. The absence of vertebrarterial canal from the cervical vertebræ in this genus is a repetition of what occurs in the Camelidæ. Four species of Macrauchenia are described (Plate XVII.).

Macrauchenia patachonica Owen was an animal of about the proportions of a mule. The posterior position of the external nostrils has suggested that the habits were aquatic, or that it possessed a short trunk like the tapir. It is a characteristic species of the Pliocene beds of Buenos Ayres. A smaller species, *M. boliviensis* Huxley, has been found in corresponding beds in Bolivia. *Scalabrintherium paranense* Brav. and *orthii* Amegh. are from Miocene beds of the Paraña. The same formation has produced the *Mesorhinus pyramidatus* Amegh., which

had the dimensions of the guanaco. No genus of the family has been yet reported from the Eocene.

The Astrapotheriidæ include the largest forms of the Litopterna, if they belong truly to this suborder. Three genera are certainly known, which differ as follows:

Dentition; I. $\frac{?}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$;
M. $\frac{3}{3}$; no diastema; *Homalodontotherium* Huxley.

Dentition; I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{2}{1}$;
M. $\frac{3}{3}$; a long diastema; *Astrapotherium* Burm.

Dentition; I. ?; C. ?; Pm. $\frac{1}{1}$;
M. $\frac{3}{3}$; a long diastema; *Listriotherium* Merc.

In Homalodontotherium the dental series is uninterrupted, and the canines are small and resemble simple premolars. The premolars differ somewhat from the molars, and the molar series

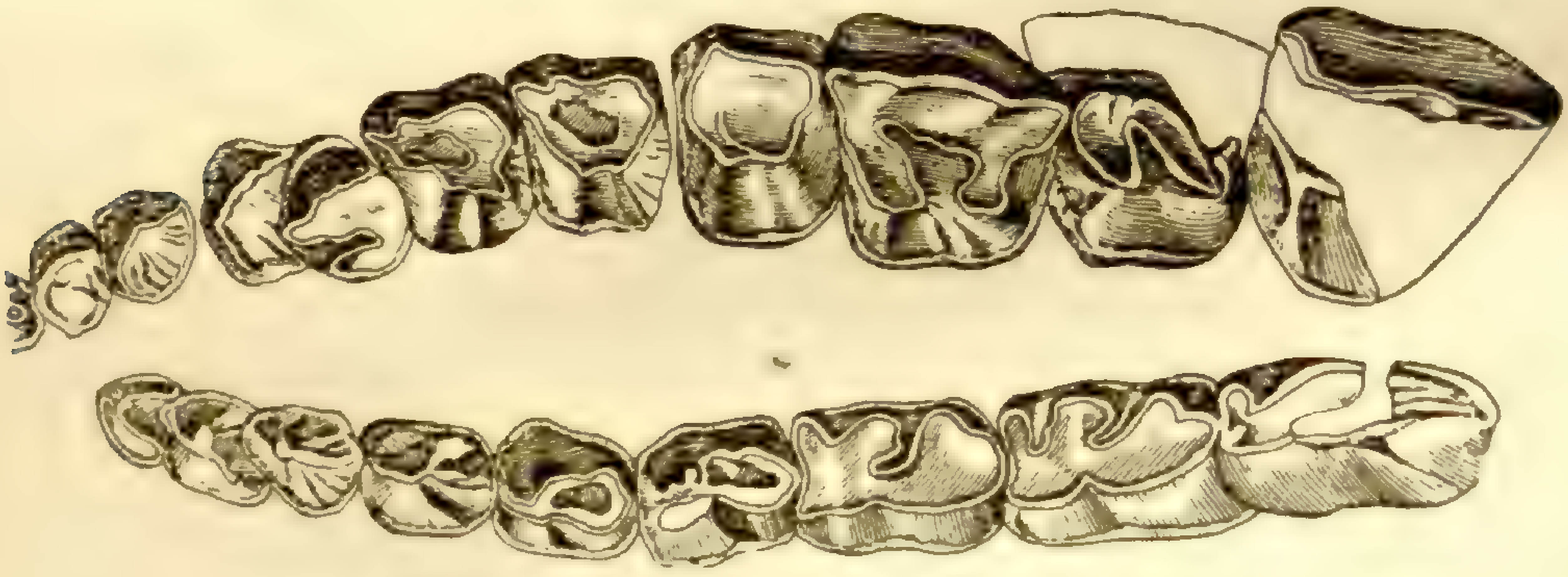
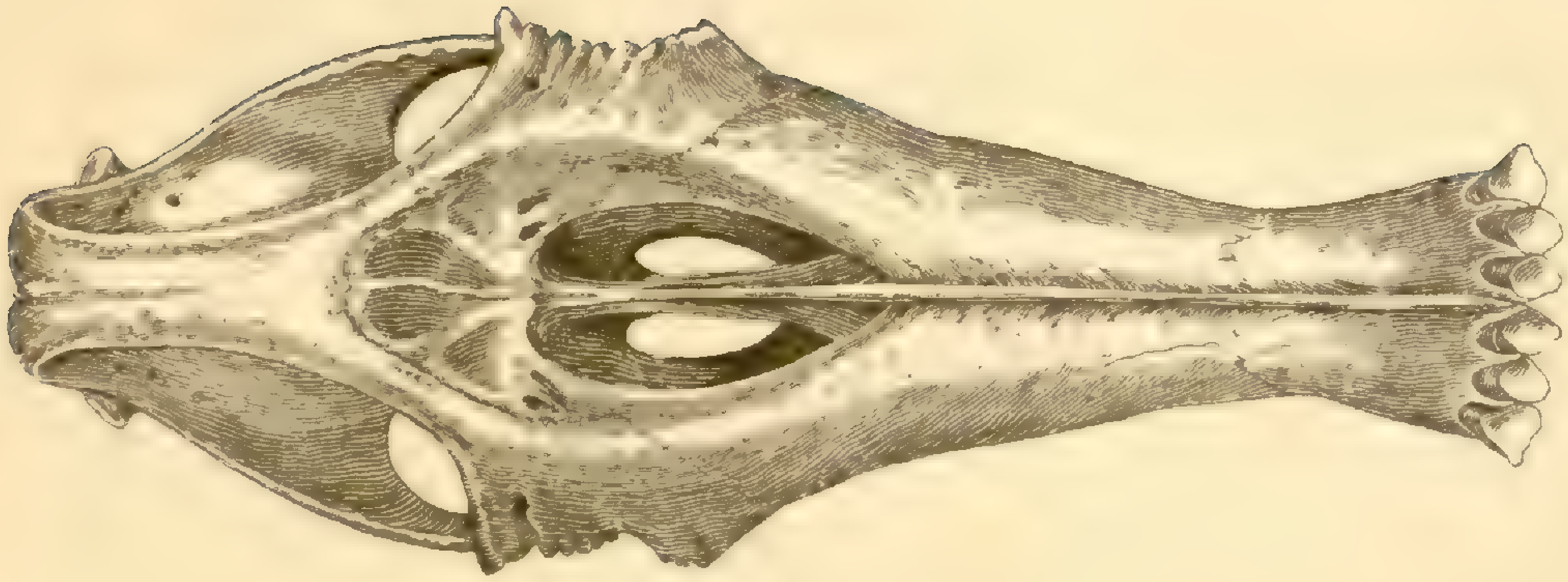


FIG. 4.—*Homaladontotherium cunninghamii* Flower; upper and lower dental series; about two-fifths natural size. From Flower.

generally has much the appearance of that of Cænopus among the rhinoceroses. In the inferior molars the resemblance is not so great, although not wanting (Fig. 4). Nothing is known of the typical and only species, *H. cunninghamii* Flower, but the dentition, and this indicates an animal of the size of an ox.

In Astrapotherium Burm. the dentition is much more specialized. The canines are large, and they are followed by a diastema. There are only two premolars above and one below. The superior premolars differ from the true molars more than is the case with Homalodontotherium, but they have the same character, —*i. e.*, an external wall, and a curved internal crest, the convexity

PLATE XVII.



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Macrauchenia patachonica Owen.

inwards. They are much smaller than the true molars (Fig. 5). Five species are known. The *A. magnum* Owen, the largest mammal of the Eocene of South America, equals a rhinoceros in

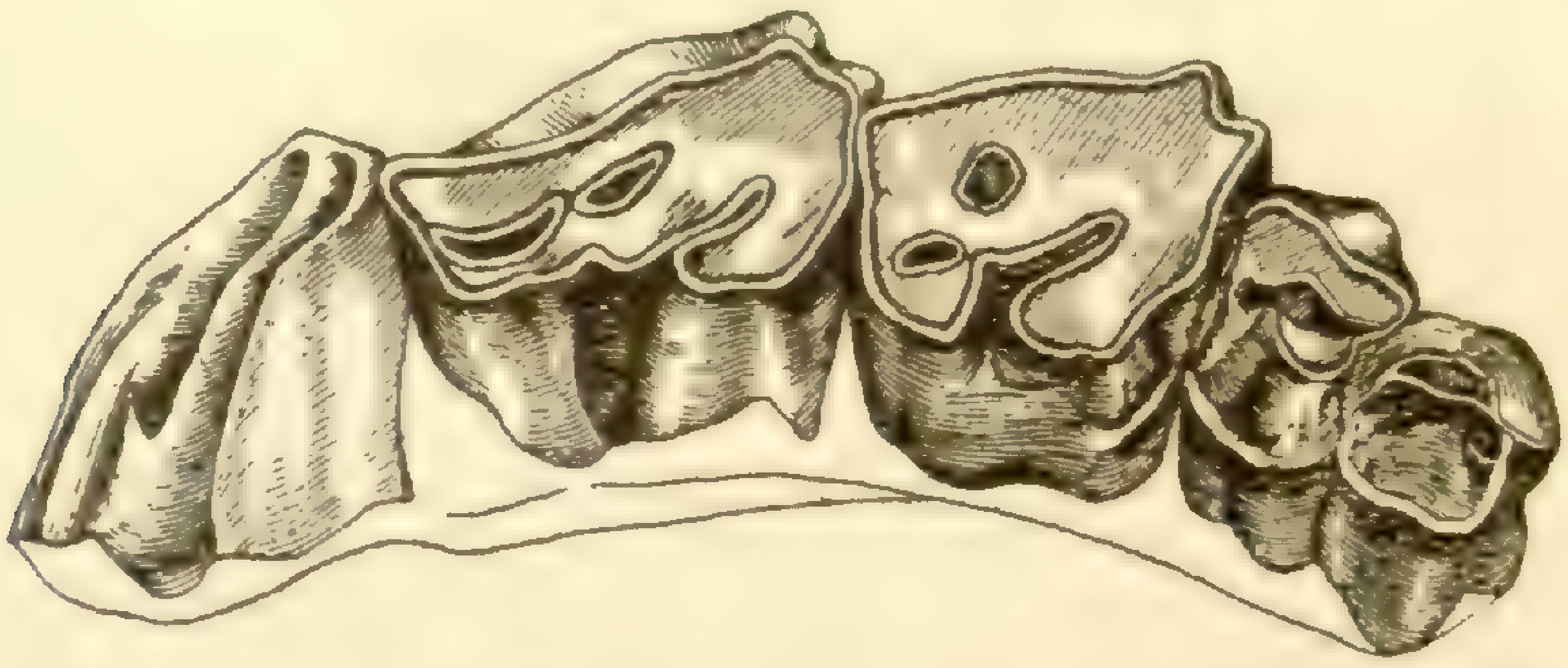

FIG. 5.—*Astrapotherium magnum* Owen; last five superior molars; about one-third natural size. From Ameghino.

dimensions. Its canine teeth, well developed in each jaw, rendered it a formidable animal.

All the species of the Astrapotheriidæ are from the Lower Eocene of Patagonia.

EXPLANATION OF PLATE XVII.

Macrauchenia patachonica Owen; from Burmeister; much reduced.

FIG. 1.—Skull from above.
FIG. 2.—Skull from below.
FIG. 3.—Superior dental series.
FIG. 4.—Inferior dental series.

THE HISTORY OF GARDEN VEGETABLES.

BY E. L. STURTEVANT.

(Continued from page 744, Vol. XXIV., 1890.)

STACHYS. *Stachys affinis* Vil.

THIS plant was introduced into cultivation by Messrs. Vilmorin-Andrieux et Cie, in 1886.[1] The roots are thick and fleshy, and are called useful for pickles, and may be used fried. According to Bretschneider,[2] the roots were eaten as a vegetable in China in the fourteenth and sixteenth centuries, and are described as a cultivated vegetable by Chinese writings of 1640 and 1742. It is used as a cultivated vegetable in Japan, and is called *choro-gi*, and, as Mr. Tamari tells me, it is esteemed.

SUGAR BEET. *Beta vulgaris* var.

These are selected forms from the common beet, and scarcely deserve a separate classification. Those figured by Vilmorin are all of the type of the half-long red, agree in being mostly underground, and in being very or quite scaly about the collar. The sugar beet has been developed through selection of the roots richest in sugar for seed-bearers. The sugar-beet industry was born in France in 1811, and in 1826 the product of the crop was 1,500 tons of sugar. The formation of the "sugar beet" could not, then, have preceded 1811; yet in 1824 five varieties, the *grosse rouge*, *petite rouge*, *rouge ronde*, *jaune*, and *blanche*, are noted,[3] and the French sugar or amber reached American gardens before 1828.[4] A richness of from sixteen to eighteen per cent. of sugar is now claimed for Vilmorin's new improved white sugar beet.[5]

[1] Vilmorin-Andrieux et Cie. Seed Cat., 1886, with figures.
[2] Bretschneider. Bot. Sin., 53, 59, 83, 85.
[3] L'Hort. Fran., 1824.
[4] Fessenden. New Am. Gard., 1828, 40.
[5] Vilmorin. Les Pl. Pot., 1883, 51.
[6] Burr. Field and Gard. Veg., 399.

The names assigned by Vilmorin to the *sugar beet* are: France, *betteraves a sucre;* Germany, *zucker-rube;* Flanders and Holland, *suiker-wortel;* Spain, *remolacha de azucar, betabel de azucar;* Portugal, *betarava branca d'assucar.*

The discovery of sugar in the beet is credited to Margraff in 1747, announced in a memoir read before the Berlin Academy of Sciences.

SWEET CICELY. *Myrrhis odorata* Scop.

This aromatic herb can scarcely be considered as an inmate of American gardens, although recorded by Burr[6] in 1863. It has also fallen into disuse in Europe, although yet retained by Vilmorin[7] among garden vegetables. In 1597 Gerarde[8] says the leaves are "exceeding good, holsom, and pleasant among other sallade herbes, giving the taste of anise unto the rest." In 1778 Mawe[9] records that it is used rarely in England. Pliny[10] seems to refer to its use in ancient Rome, under the name *anthriscus.* It finds notice in most of the early botanies.

Sweet cicely or *sweet-scented chervil* or *sweet fern* is called in France, *cerfeuil musque, cerfeuil d'Espagne, cerfeuil anise, cicutaire odorante, fougere musquee, myrrhide odorante, persil d'ane de Lobel;* in Germany, *grosser spanischer wohlriechender kerbel;* in Flanders, *spaansche kervel;* in Denmark, *spansk kjorvel;* in Italy, *finocchiella*[7] or *mirride.*[11]

SWEET MARJORAM. *Origanum* sp.

But two species are enumerated by Vilmorin for European culture, but several other species were formerly grown. The leaves of all are used for seasoning.

Origanum vulgare L.

This aromatic herb, a native of Europe, has become naturalized sparingly in the Atlantic states, and is quite variable, affording a dwarf variety to culture. It is supposed to be the *Cunila*

[7] Vilmorin. Les Pl. Pot., 1883, 79.
[8] Gerarde. Herb., 1597, 883.
[9] Mawe. Gard., 1778.
[10] Pliny. Lib. XXII., c. 38.
[11] Pickering. Ch. Hist., 488.

bubula of Pliny,[12] and the *Origanum* of Albertus Magnus[13] in the thirteenth century. It is not, however, indicated as cultivated. It is called "English wilde marjerome" by Gerarde[14] in 1597, and "wild marjoram" by Ray[15] in 1686, who describes also the dwarf variety. It is mentioned as cultivated by Mawe[16] in 1778, but not by Bryant[17] in 1783, although a hundred years earlier Meager[18] gives the English name of "pot or wild marjoram" to one of the cultivated varieties, and includes also the "pide," which is probably the variety with variegated foliage mentioned by Burr,[19] who enumerates this species among American garden plants. Its culture is also mentioned by Worlidge in 1683, who enumerates the partly colored and the white varieties.

Common marjoram, pot marjoram, or *perennial marjoram* is called in France, *marjolaine vivace;* in Germany, *winter-marjoram;* in Flanders, *orego;* in Denmark, *merian;*[20] in France also, *origan;* in Germany, *dosten;* in Italy, *regamo* or *origano;* in Greece, *rigani* or *riganon;*[21] in Telinga, *mridu-maruvamu.*[22]

Origanum majorana L.

This is the species usually present in the herb-garden. It is supposed to be the *amaracus* of Pliny,[23] who speaks of it as cultivated. It is also the *marjorana* of Albertus Magnus[24] in the thirteenth century, and is mentioned as cultivated in the early botanies. Its modern culture is quite extended, and at Bombay it is considered sacred to Siva and Vishnu.[25] It is said to have

[12] Pliny. Lib. XX., c. 61.
[13] Albertus Magnus. De Veg., Jessen Ed., 544.
[14] Gerarde. Herb., 1597, 541.
[15] Ray. Hist., 1686, 539.
[16] Mawe. Gard., 1778.
[17] Bryant. Fl. Diet, 1783.
[18] Meager. Eng. Gard., 1683, 86.
[19] Burr. Field and Gard. Veg., 1863, 427.
[20] Vilmorin. Les Pl. Pot., 328.
[21] Pickering. Ch. Hist., 261.
[22] Birdwood. Veg. Prod. of Bomb., 65, 242.
[23] Pliny. Lib. XXI., c. 35.
[24] Albertus Magnus. L. c., 537.
[25] Birdwood. L. c., 368, 242.

reached Britain in 1573,[26] and was a well-known inmate in American gardens in 1806.[27]

Sweet marjoram, *knotted marjoram*, or *annual marjoram* is called in France, *marjolaine a coquille;* in Germany, *majoran, franzosischer majoran;* in Flanders and Holland, *marjolijn;* in Italy, *maggiorana;* in Spain, *mejorana, almoraduj;* in Portugal, *manjerona;*[28] in Norway, *merian;*[29] in Greece, *masouran, mantziourana;* in Egypt and Yemen, *mardakusj;* in Hindustani, *marzanjosh, marwa, nazbo;*[30] in Arabic, *mirzunjoosh, mardakusch;* in the Deccan, *murwa;* in Tamil, *marroo;*[25] in the Mauritius, *marjolaine.*[31]

Origanum onites L.

Pliny[33] speaks of this species as called *onitin* or *prasion* in the first century, but its introduction to Britain is said to have taken place in 1759.[32] It was in American gardens in 1806,[27] but does not appear to have been much cultivated, although recorded by Burr in 1863. Its name does not now occur in our seed-lists, as it is inferior to the preceding variety.

This species has been called *pot marjoram*, a name which has been applied to the *O. vulgare.*

Origanum heracleoticum L.

This species has been identified with the *Cunila gallinacea* of Pliny.[34] It is mentioned in the early botanies, and is said to have reached England in 1640,[35] and is recorded in American gardens in 1806.[36] It finds mention by Burr in 1863, but seems now to have disappeared from our seed-lists. It is frequently mentioned by early garden writers under the name of *winter sweet marjoram*, and has a variegated variety.

[26] McIntosh. Book of the Gard., II., 238, 239.
[27] McMahon. Am. Gard. Cal., 1806.
[28] Vilmorin. L. c.
[29] Schubeler. Culturpf., 89
[30] Pickering. L. c., 248.
[31] Bojer. Hort. Maur., 248.
[32] Don. Gard. and Bot. Dict., IV., 767.
[33] Pliny. Lib. XX., c. 67.
[34] Pliny. Lib. XX., c. 62.
[35] McIntosh. L. c., II., 238.
[36] McMahon. L. c.

SWEET POTATO. *Convolvulus batatas* L.

This widely distributed cultivated plant, originally of South and Central America, had developed many varieties at the period of its discovery by Columbus. Peter Martyr[37] in his second decade, written about 1514, mentions *batatas* as cultivated in Honduras, and in his third decade he gives the names of nine varieties. In 1526 Oviedo[38] not only mentions sweet potatoes in the West Indies, but says they have often been carried to Spain, and that he had carried them himself to Avila, in Castile. In Peru, Garcilasso de Vega[39] says the "apichu" are of four or five different colors, some red, others yellow, others white, and others brown, and this author was contemporary with the conquest. The "camote" of Yucatan, called in the islands *axi* and *batatas*, is mentioned in the fourth voyage of Columbus,[41] and Chanca, physician to the fleet of Columbus, in a letter dated 1494, speaks of *ages* as among the productions of Hispaniola. In Europe, sweet potatoes are mentioned by Cardan[42] in 1556, and Clusius,[43] in 1566, describes the red or purple and the pale or white sorts as under culture in Spain, and in 1576 he notes that their culture had been attempted in Belgium. Their mention hereafter in the early botanies are frequent. Their culture is noted for Virginia before 1650.[44] In 1750 Hughes[45] says that at least thirteen sorts are known at the Barbadoes, and Wilkes[46] notes that in the Hawaiian Islands, where the sweet potato had been introduced, there are thirty-three varieties, nineteen of which are of a red color and thirteen white. On the Mauritius, Bojer[47] describes the round and long forms, white and purple. At the present time Vilmorin[48] describes two varieties in France, and in

[37] Peter Martyr. Eden's Hist. of Trav., 1577, 88, 143.
[38] Oviedo. Quoted by Gray and Trumbull, *Am. Jour. Sci.*, April, 1883, 248.
[39] G. de Vega. Roy. Com. Hak. Soc., Ed. II., 359.
[40] Gen. Coll. of Voy. by the Port., 1789, 440.
[41] Pharmacographia, 1879, 452.
[42] Cardanus. De Rerum Var., 1556, 189.
[43] Clusius. Hisp., 1576, 297.
[44] Virginia. By E. W., 1650.
[45] Hughes. Barbadoes, 1750, 228.
[46] Wilkes. U. S. Exp. Exp., IV., 282.
[47] Bojer. Hort. Maurit., 225.
[48] Vilmorin. Les Pl. Pot., 401.

1863 Burr[49] describes nine varieties as in American gardens. Of the varieties now known to me, not one type can be considered as modern in its appearance.

The *sweet potato* is called in France, *potate douce*, *batate*, *artichaut des Indes*, *truffe douce;* in Italy, *patata;* in Spain and Portugal, *batata*.[48]

Other names have been, in English, in 1597, *potatoes*, *potatus*, and *potades* (Ger.); by Clusius, 1576, *batatas*, *camotes*, *amotes*, and *ajes*.

Native American names are, in Peru, *apichu* (Piso. de Vega); at Quito, *cumar* (Markham); in Brazil, *jetica* (Piso. Marcg.), *jettiki* (Hans Stade); by the Portuguese in Brazil, *batata* (Marcg.), *patattes* (Nieuhoff); in Mexico, *camote* (Unger); in Carib, *maby* (Descourt.); in Tupi, *hetich* (Gray); in Tupi-Guarani, *yeti* (Gray); in Yucatan, *camote* (Port. Voy.); in Choctaw, *ahe* (Gray).

Other names are, in New Zealand and Otaheite, *cumala* (Cook); in New Zealand, *kumara* (Wilkes); in Malay, *ubitora;* Javanese, *ubi;* Chinese, at Batavia, *hantsoa* (Nieuhoff); Central Africa, *veeazee* (Grant); East Africa, in Wanika-land, *fiasi* (Krapf.); in the Soudan, *dankali*, *doukali* (Heuze).

In India, *shukar-kundo* (Firm.); in Bengali, *shukar-kundoo-aloo;* in Telinga, *chillagada*, *grasugada* (Drury); in Hindustani, *pendaloo;* in Tamil, *sukkaray-vullie;* in Ceylon, *batala;* in Persian, *zardak-lahori;* in Malay, *batatas* (Birdwood); in Japan, *imo*, *kara imo* (Thunb.).

TANSY. *Tanacetum vulgare* L.

Tansy is still included in the herb-garden as a condimental and medicinal herb, yet it is very little grown, the wild plant usually sufficing for all purposes, and it very readily becomes an escape, thriving in out-of-the-way places without culture. It was formerly in greater esteem than at present. In 1633 Gerarde[50] says: "In the spring-time are made with the leaves hereof newly sprung up, and with egs, cakes, or tansies, which be pleasant in taste, and good for the stomacke." In 1778 Mawe[51] says: "This

[49] Burr. Field and Gard. Veg., 1863, 99.

[50] Gerarde. Herbal, 1633, 651.

[51] Mawe. Gard., 1778.

herb for its economical uses in the kitchen and medicine merits culture in every garden," and names for varieties the plain-leaved, the curled-leaved, the variegated-leaved, and the scentless. Both the common and the curled are figured by Dodonæus[52] in 1616, and are mentioned in other botanies of this period. It was in American gardens before 1806.

Tansy[53] or *tansie*[54] is called in France, *tanaisie, barbotine, herbe amere, herbe aux vers, tanacee;* in Germany, *gemeiner rainfarn, revierblume, wurmkraut;* in Denmark, *reinfang;* in Italy, *atanasia, tanaceto, erba santa-maria;* in Spain, *tanaceto.*[53]

TARRAGON. *Artemisia dracunculus* L.

This plant, widely spread over South Russia, was brought to Italy, probably from the shores of the Black Sea, in more recent times. The first mention on record is by Simon Seth, in the middle of the twelfth century, but it appears to have been scarcely known as a condiment till the sixteenth century.[55] The leaves make an excellent pickle, and are sometimes used in soups and salads. The flowers, as Vilmorin says, are always barren, so the plant can only be propagated by division. Its culture is mentioned by the botanists of the sixteenth century, and in England by Gerarde[56] in 1597, and by succeeding authors on gardening. Rauwolf,[57] 1573–'75, found it in the gardens of Tripoli. In America it is mentioned by McMahon[58] in 1806.

Tarragon is called in France, *estragon, absinthe estragon, dragonne, fargon, herbe dragon, serpentine, torgon;* in Germany, *dragon, bertram, esdragon, schlangenkraut;* in Flanders and Poland, *dragonkruid;* in Denmark, *estragon, kaisersalat;* in Italy, *dragoncello, targone, serpentaria;* in Spain, *estragon;* in Portugal, *estragas.*[59]

[52] Doronæus. Pempt., 1616, 36.
[53] Vilmorin. Les Pl. Pot., 1883, 552.
[54] Turner. Libellus, 1538.
[55] Targioni-Tozzetti. Hort. Trans., 1854, 148.
[56] Gerarde. Herb., 1597, 193.
[57] Gronovius. Orient., 106.
[58] McMahon. Am. Gard. Cal., 1806, 511.
[59] Vilmorin. Les Pl. Pot., 207.

THYME. *Thymus vulgaris* L.

A plant native to the southern countries of Europe, and which has been long cultivated in more northern countries. In English culture it is recorded about 1548,[60] and it is mentioned by Gerarde in 1597, and succeeding authors. It succeeds as an annual even in Iceland,[61] and is recorded as grown in the tropical gardens of the Mauritius.[62] Three varieties are known: the narrow-leaved, *Thymus vulgaris, tenuiore folio* of Bauhin,[63] 1596; the broad-leaved, *Thymus vulgaris, latiore folio* of Bauhin,[63] 1596; and the variegated, *Thymus variegato folio* of Tournefort,[64] and also mentioned by Bauhin[65] in 1623. It was known in American gardens in 1806[66] or earlier, and the broad-leaved kind is the one now principally grown in the herb-garden for use in seasonings.

The *common*, *French*, or *narrow-leaved thyme* is called in France, *thyme ordinaire*, *faligoule*, *farigoule*, *frigoule*, *mignotese du Genevois*, *pote*, *pouilleux*; in Germany, *franzosischer thymian*; in Flanders, *thijmus*; in Holland, *tijm*; in Denmark, *thimian*; in Italy, *timo*, *pepolino*; in Spain, *tomillo*; in Portugal, *tomilho*;[67] in Norway, *timian*;[68] in Arabic, *hasha*; in Hindustani, *ipar*;[69] in India, *espar*.[70]

Thymus serpyllum L.

This is a very variable plant, occurring wild in Europe, and sparingly naturalized in some localities in Northeastern America. In 1726 Townsend[71] speaks of it in English gardens, but not as a pot-herb; but it is placed among American pot-herbs by McMahon[66] in 1806. At the present time it is occasionally used

[60] Booth. Treas. of Bot.
[61] Pharmacographia, 1879, 487.
[62] Bojer. Hort. Maur., 1837, 248.
[63] Bauhin. Phytopin., 1596, 414.
[64] Tournefort. Inst., 1719, 196.
[65] Bauhin. Pin., 1623, 219.
[66] McMahon. Am. Gard. Cal., 1806.
[67] Vilmorin. Les Pl. Pot., 553.
[68] Schubeler. Culturpf., 89.
[69] Birdwood. Veg. Prod. of Bomb., 66, 243.
[70] Speede. Ind. Handb. of Gard., 182.
[71] Townsend. Seedsman, 1726, 35.

for seasoning in England. In Iceland it is used to give an agreeable flavor to sour milk.[72]

Wild thyme or *mother of thyme* is called also in Britain, *pell-a-mountain;* in France, *serpolet;* in Germany, *quendel;* in Italy, *sermollino, selvatico, serpillo;* in Yemen, *saater.*[73]

Thymus citriodorus Pers.

This plant is considered by many botanists as but a variety of the preceding. It was described by Bauhin in 1623, and was in American gardens in 1806. The odor of the leaves is quite agreeable, and it is thought to be a desirable seasoning for veal.

Lemon thyme is the *thyme citronne* of the French.

TOMATO. *Lycopersicum* sp.

The earliest mention I find of tomatoes is by Matthiolus[74] in 1554, who calls them *pomi d'oro*, and says they have but recently appeared [in Italy]. In 1570, Pena and Lobel[75] give the name *gold apple* in the German, Belgian, French, and English languages, which indicates their presence in those countries at this date. In 1578 Lyte[76] says in England they are only grown in the gardens of "Herboristes." Camerarius in his Epitome, 1586,[77] gives the French name of *pommes d'amours*, which corresponds to Lyte's *amorous apples;* and in his Hortus Medicus, 1588,[78] gives the names as *pomum Indum*, and the foreign name of *tumatle ex Peruviana;* but Guilandinus of Padua in 1572 had the name *tumatle americanorum*, and Anguillara in 1561 names them *poma Peruviana.*[79] In Hernandez's history of Nova Hispania, 1651, he has a chapter on the *tomatl*, which includes our tomatoes and alkekengis, and in 1658 the Portugese of Java used the word

[72] Burgsman. Gard. Chron., Dec. 25th, 1886, 810.
[73] Pickering. Ch. Hist., 272.
[74] Matthiolus. Com., 1558, 479; 1570, 684.
[75] Pena and Lobel. Adv., 1570, 108; 1576, 108.
[76] Lyte's Dodœns, 1578, 508.
[77] Camerarius Epit., 1586, 821.
[78] Camerarius. Hort., 1588, 130.
[79] Gray. *Am. Jour. of Sc.*, Aug., 1883, 128.

tamatas.[80] Acosta,[81] however, preceding 1604, used the word *tomates*, and Sloane,[82] in 1695, *tomato*.

Both the yellow and the red-fruited are named by Matthiolus[74] in 1554, but the prevalence of the name *golden apple* in the various languages would indicate that this was the color most generally distributed. The shades are given as golden by Matthiolus 1554, ocher yellow by J. Bauhin[83] in 1651, and deep orange by Bryant[84] in 1783. I give only the first authors when the color is mentioned, and do not follow with succeeding authors, who are many.

The red color is noted by Matthiolus,[74] 1554, the pale-red by Tournefort[85] in 1700, and the purple-red in the Adversaria,[75] 1570.

The white-fruited is named by Lyte[76] in 1578, by Bauhin[86] in 1596, etc.

The versicolored by J. Bauhin[83] in 1651.

The bronze-leaved is indicated in Blackwell's Herbarium,[87] 1750.

The cultivated species, following Dunal,[88] are *Lycopersicum pimpinellifolium* L., *L. pyriforme* L., *L. humboldtii* L., *L. cerasiforme* L., and *L. esculentum* L. If these species are well founded, then it seems as if an additional species should be formed which hould include our globular, smooth, unribbed sorts, and this we must do if we would follow out the history of the varieties.

Lycopersicum esculentum Dun.

This is the common species, with flattened and more or less ribbed fruit, and is the kind first introduced into European culture, being described in the Adversaria of 1570, as well as by many succeeding authors, and the earlier figures indicate that it has changed but little under culture, and was early known as

[80] Bontius. Ind. Orient., 1658, 131.
[81] Acosta. Hist., 1604, 266.
[82] Sloane. Cat., 1696, 109.
[83] J. Bauhin. Hist., 1651, III., 620.
[84] Bryant. Fl. Diet., 1783, 212.
[85] Tournefort. Inst., 1719, 150.
[86] Bauhin. Phytopin., 1596, 302.
[87] Blackwell. Herb., 1750, t. 133.
[88] Dunal. Solanaceæ, III.

now in red, golden, yellow, and white varieties, and a parti-colored fruit is mentioned by J. Bauhin in 1651, and the type of the bronze-leaved by Blackwell in 1770. It was probably the kind mentioned by Jefferson [89] as cultivated in Virginia in 1781, as it was the kind whose introduction into general culture is noted from 1806 to about 1830, when their growing was becoming general.

It has the following synonymy, gained from figures:

Poma amoris, an Glaucium Diosc. Lob. obs., 1576, 140.

Poma amoris. Lyte's Dod., 1578, 440. Cam. Epit., 1586, 821; Ger., 1597, 275; Swert., 1654, t. 20, p. 2.

Poma aurea. Lugd., 1587, 628.

Poma amoris, pomum aureum. Lob. ic., 1591, I., 270.

Solanum pomiferum, fructu rotundo, molli. Matth. op., 1598, 761.

Poma amoris fructu luteo et rubro. Hort. Eyst., 1613; 1713.

Aurea mala. Dod., 1616, 458; 1583, 455.

Pomi d'oro. Cast. Dur., 1617, 372.

Pomum amoris majus. Park. Par., 1929, 381, f. 3.

Amoris pomum. Blackw., 1750, t. 133.

Mala aurea. Chabr., 1677, 525. J. B., 1650, 3, 620.

Solanum pomiferum. Mor. Hist., 1699, s. 13, t. 1, f. 7.

Lycopersicon. Tourn., 1719, t, 63.

Lycopersicon galeni. Morandi, 1744, t. 53, f. 8.

Common Large Red. Mawe, 1778.

Morelle pomme d'amour. Descourt., 1827, VI., 95.

Tomate rouge grosse. Vilm., 1883, 555.

Large Red. Burr, 1863, 646.

In form these synonyms are substantially of one variety. The descriptions accompanying and others of the same date mention all the colors now found. In 1719 Tournefort names a pale red, red, a yellow, and a white variety in France, and in 1778 Mawe but the common large red in England. In 1854 Brown describes but two varieties, the large red and the large yellow, for American gardens. The *Lycopersicum esculentum* L. is said by Bojer to grow spontaneously in the Mauritius [as an escape].

[89] Jefferson. Notes, 1803, 54.

Lycopersicum rotundum.

I here place the larger unribbed round or oval varieties which are now becoming popular, and also the fancy varieties known as the plum, but I would not have it understood that at present I consider this group as forming a true species in the botanical sense, for my studies are not yet sufficiently complete. Of this group there are no indications of their being known to the early botanists, the first apparent reference I can detect being by Tournefort in 1700,[90] who places among his varieties the *Lycopersicum rubro non striato*, and this same variety was catalogued by Tilly[91] at Pisa in 1723. The *non striato* not fluted or ribbed, implying the round form. In 1842 some seed of the Feejee Island variety was distributed in Philadelphia, and Wilkes[92] describes the fruit of one variety as round, smooth, yellow, the size of a large peach, and the fruit of two other varieties as the size of a small egg, but gives no other particulars. This is the first certain reference that I find to this group. The large smooth or round red and the small yellow oval tomato of Browne,[93] 1854, may belong here. Here may be classed such varieties as Hathaway's Excelsior, King Humbert, and the Plum, and some of the *tomate pomme* varieties of the French.

This form occasionally appears in the plants from seed of hybrid origin, as when the cross was made between the currant and the tree tomato, some plants thus obtained yielded fruit of the plum type. This, however, may have been atavism. The botanical relations seem nearer to the cherry tomato than to the ordinary forms.

Lycopersicum cerasiforme Dun.

The cherry tomato is recorded as growing spontaneously in Peru,[88] in the West Indies,[82] Antilles,[94] and Southern Texas.[95] I have also observed it in a railroad cutting in New Jersey. It furnishes red and yellow varieties, and was noted in Europe as

[90] Tournefort. Inst., 1719, 150.
[91] Tillius. Cat, Hort. Pisa, at Pisa, 1723, 106.
[92] Wilkes. U. S. Exp. Exped., III., 335.
[93] Browne. U. S. Pat. Of. Rept., 1854, 385.
[94] Descourtilz. Fl. Ant., V., 279.
[95] Gray. Syn. Fl., II., 226.

early as 1623,[97] and is mentioned in 1783 by Bryant[98] as if the only sort in general culture in England at this time, but Mawe,[99] in 1778, enumerates the large red, as also the red and yellow cherry, as under garden culture. The following is its synonymy, mostly founded on description:

Solanum racemosum cerasorum. Bauh. Pin., 1623, 167; Prod., 1671, 90.

Solanum amoris minus, S. mala æthiopica parva. Park. Par., 1629, 379.

Cujus fructus plane similis erat, magnitudine, figura, colore, Strychnodendro, etc. Recchius Notes, Hernand., 1651, 296.

Fructus est cersasi instar (quoad magnitudine), Hort. Reg. Bles., 1669, 310.

Solanum pomiferum fructu rotundo, molli parvo rubro plano. Ray, 1704, III., 352.

Lycopersicum fructu cerasi rubro. Tourn., 1719, 150.

Lycopersicum fructu cerasi luteo. Tourn., 1719, 150.

Solanum lycopersicum. Bryant, 1783, 212.

Cherry-fruited. Mawe, 1778.

Cherry. Mill. Dict., 1807; Burr, 1863, 649, 652.

Morelle cerasiforme. Descourt., 1827, V., 279, t. 378.

Lycopersicum cerasifolium. Noisette, 1829.

Cherry-shaped. Buist, 1851.

Tomate cerise. Vilm., 1883, 559.

This species is probably the normal form of the tomato of the gardens, to which the other species above given can be referred as varieties. It is quite variable in some respects, bearing its fruit sometimes and usually in clusters, occasionally in racemes. It is but little grown, and then only for use in preserves and pickles.

(*To be continued.*)

RECORD OF NORTH AMERICAN ZOOLOGY.

BY J. S. KINGSLEY.

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EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

AMONG the many uncritical propositions urged by would-be reformers in recent years, few are more so than some of those anent the interesting subject of women's waists. We are repeatedly told that a narrow waist is a deformity produced by artificial compression, and that the just model for the healthy normal woman is the robust and matronly Venus of Milo. Now the anthropologist knows that this general assertion is not true as applied to the civilized white woman. It is especially characteristic of the highest types of woman of the Indo-European race to have wide hips and a narrow waist, up to the age when adipose tissue fills to greater uniformity of outline, the graceful curve which is so generally admired. It is well known that the form of the pelvis differs in the different races, so that in the white race the female pelvis differs from that of the male more than is the case with the African. In the latter the female pelvic strait is as in the male, longer in anteroposterior than in transverse diameter; in the female Mongolian the strait is subquadrate in outline, while in the Indo-European the strait is oval, with the transverse diameter greater than the anteroposterior. Thus the white woman has wider hips than the woman of inferior races, and she is in so far more unlike the male than they. The larger pelvic cavity of the female is an adaptation to the increase in the bulk of its contents incident to gestation; and it follows that when this cavity is not so occupied, the moveable viscera fill the space. From this results the contraction of the abdominal walls immediately above the pelvis known as the waist. It is then clear that the diameter of the waist is inversely as the diameter of the pelvis, and the differential of diameter is greatest as the transverse diameter of the pelvis exceeds the anteroposterior.

The cause of the increased transverse diameter of the Indo-European pelvic strait is probably mechanical. It may be due

to anteroposterior pressure on the pubic arch. This in turn may be a consequence of the monogamic customs of the Indo-European subspecies due to the greater esteem in which women are held. But on this point we can only speculate.

In any case the Venus of Milo has the form of a very mature woman of her race, and many moderns can boast of far more graceful figures than she. And these figures are not the result of artificial compression of the clothing, but are the product of a natural evolution of form. It is true, however, that all women of the white race have not attained this stage, and not a few retain the figure of lower races. It is not, however, proven that the women possessing this figure are any better child-bearers than those of modern type. Occasionally we meet women who to a robust waist add a narrow pelvis,—an unfortunate structure, and one not likely to be extensively reproduced, owing to the difficult parturition which is indicated.

The women who are not satisfied with the figures which nature has given them, and who endeavor to reduce a naturally robust waist to the proportions which characterize their more favored sisters by artificial means, deserve all the reprobation which the above-mentioned reformers bestow so undiscriminatingly on all alike. Excess of slenderness is not beautiful, and artificial compression forces the viscera into positions which produce a deformity of the abdominal wall more repulsive than a stout waist.—C.

—Laboratories of Marine Biology have been established at various localities for the purpose of enlarging our knowledge of animal and vegetable structure, development, and function, and to furnish a headquarters for the instruction of the entire community in all matters connected with increased supply, avoidance of disease, and cultivation of more varieties of sea foods.

Some idea of the extent to which the important bearings of Laboratories of Marine Biology are appreciated and encouraged abroad may be gained from the following list, which will make clear at the same time how much America is behind other nations in giving scientific oversight to one side of the question of cheap and plentiful food supply, a question growing in importance in

direct ratio with the growth of population. The first of the laboratories named in the list, that of Naples, has cost, in permanent plant alone, over $100,000, and is carried on at an annual expense of $20,000. The laboratory and fittings of the English station, at Plymouth, were completed at a cost of over $60,000, raised by subscription. The two Austrian and the eight French stations have been fostered by the intelligent and progressive men of their respective countries, and have given abundant returns in practical contributions to knowledge. The Japanese station has, during its few years of existence, done much to alleviate certain sources of public distress. The following list represents the number of such stations and the countries where they are situated: Italy, 1; Austria, 2; France, 8; Holland, 2; Belgium, 1; Germany, 1; Sweden, 2; Great Britain, 5; Russia, 1; Japan, 1; New South Wales, 1. In the United States we have one at Wood's Holl, Mass., and one under charge of the U. S. Fish Commission, at the same place. In the wide range of our Atlantic and Gulf coasts south of Wood's Holl no station exists.

Through the energy of Prof. C. S. Dolley, of the University of Pennsylvania, and the liberality of Mr. Chas. K. Landis, of Vineland, New Jersey, ground has been obtained at Sea Isle City, Cape May County, N. J., and a commodious building has been erected on it to serve as a station for biological research.

The final establishment of the Laboratory of Marine Biology upon the New Jersey coast is the outcome of a long and careful consideration of ways and means, undertaken by the University of Pennsylvania, to ascertain how it could best meet its own needs and the requirements of biologists at large.

To place the laboratory upon the more northerly New England coast necessitated its closure during the winter months on account of climatic conditions.

To have accepted the offers of suitable properties in Florida, or the Bahama Islands, would have necessitated the absence of a number of the university's staff of naturalists during the collegiate year, when their services are particularly needed at home. Comparative inaccessibility applied to either alternative. The decision in favor of the present location of the laboratories is based upon

the fact that the fauna of the New Jersey shore waters and of its numerous bays and thoroughfares is exceedingly rich, uniting to a degree, greater perhaps than any other locality, the northern and southern marine faunas. The plants of New Jersey are also peculiarly interesting from the standpoint of climatology and geographical distribution. New Jersey occupies a central position as regards the great oyster industries of the country, midway between Rhode Island and Virginia. Access is quick and easy to the greatest centers of oyster consumption and distribution, —viz., Baltimore, Philadelphia, and New York. The desirability of the location is enhanced also from its proximity to three of the greatest intellectual and scientific centers of the country, the University of Pennsylvania, Columbia College, and Johns Hopkins University, enabling the work of the laboratories to be conducted in thorough accord with the university idea, and available to the considerable number of naturalists congregated at these institutions and in the scientific organizations of the three great cities. Ready access to the unsurpassed libraries and collections of these three cities, and particularly to those of the Academy of Natural Sciences of Philadelphia, urged strongly in favor of the present location.

An examination of the U. S. Coast Survey charts will show a gradual widening of the littoral area towards the southern end of New Jersey. This great shoal-water area is the home of myriads of interesting marine animals, and the spawning and feeding grounds of an equally important series of fishes, etc. The numerous bays and the intricate maze of thoroughfares running back through the salt meadows to the mainland are equally interesting from a biological standpoint.

Sea Isle City, situated on Ludlam Island, affords unsurpassed facilities for the utilization of this rich field for investigation. It has direct railroad connection with New York and Philadelphia by numerous fast trains, good harborage for collecting-boats, and Ludlam Bay, with its oyster grounds of several hundred acres, awaiting only the suggestions of the naturalist to replenish them, and counterbalance the short-sighted policy of the oystermen. Sea Isle City is located in an area the hard sand beach of which

shelves in the most gradual manner for a distance of several miles below the sea-level. It is underlaid with a tenacious, black alluvium, representing submerged meadow-land, and from the permanency which this gives it, forms a favorite habitat to mollusks of great number and variety, so much as to have gained the name of "Shell Beach" among the inhabitants of this region.

The scientific staff consists of Professors Dolley (Director), Jayne, Ryder, Wilson, and Cope.

—ATTENTION may be directed to the shortness of the time permitted the meeting of the American Association for the Advancement of Science, to be held in Washington, commencing August the 19th. As originally announced it was to have closed on August the 22d, thus covering only four days, of which three may be regarded as working days. It is then succeeded by a two-days' session of the Geological Society of America. By a new arrangement the two societies now overlap their sessions. Equally inexplicable is the proposition to have the papers of foreign geologists read before this society. Is there a scheme on foot to extinguish the congress? or is this only one more illustration of the confusion of geological ideas that naturally emanates from Washington? We are of the opinion that there is no proper reason for a meeting of the Geological Society in the summer. The meeting during the winter holiday seems to satisfy all requirements.

—IT IS still far from certain that the execution by electric shock is more humane than that by hanging. No detailed report of the recent execution of four men at the New York State prison has been yet made public, and some of those authorized to make it, appear to have a prejudice in favor of this mode of execution. The only details which have been reported so far include two remarkable statements. One is that these men, as was the case with Kemmler, required two discharges to kill them. The other was that the face of the only one of the four men which was seen by an outsider, was seamed with burns, and that a hole was burned in the leg to the bone. That a portion of the dis-

charge passed over or near the surface of the body of Kemmler was stated in the reports, and the similar statement in this case requires explanation. The sentiment of humanity and decency must be satisfied in this matter.

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RECENT LITERATURE.

Ameghino on the Extinct Mammalia of Argentina.[1]—We have here a monumental work, such as can only be produced under circumstances which seldom concur. The conditions are, first, rich and newly discovered fossiliferous deposits; second, a man who is competent to study and describe them; and third, facilities for publication. Such a coincidence created the Ossemens Fossiles of Cuvier in Europe; a similar state of affairs has produced corresponding works in North America; and now South America has come forward with a history and a historian worthy to take rank with anything that has gone before. The richness of the Pampean beds of Buenos Ayres has been made known to us by Owen and Burmeister, but it has been for Ameghino to bring to our notice the extraordinary wealth of the Miocene and Eocene beds of the Parana and of Patagonia. Indeed, the wealth of Patagonia, of which a few jewels were brought home by Darwin, turns out to be extraordinary, and the explorations conducted by Senor Carlos Ameghino, brother of the author of this book, have been more productive than those of any other known region, those of some parts of North America alone excepted.

The orders of Mammalia most abundantly represented are those of which examples had been already brought to light in a comparatively small number of representatives by previous explorers. The number of genera and species enumerated by M. Ameghino is as follows:

	Genera.	Species.
? Marsupialia,	8	24
Edentata,	70	188
Glires,	71	177
Bunotheria (Creodonta),	8	9
Carnivora,	13	44
Chiroptera,	11	16
Taxeopoda (Litopterna),	14	23
(Quadrumana),	4	4
Toxodontia,	28	71
Diplarthra (Perissodactyla),	7	14
(Artiodactyla,	18	46
Cetacea,	13	17
Incertæ sedis,	4	4
Proboscidia,	1	6
Total,	286	643

[1] Contribucion al Conocimento de los Mamiferous Fosiles de la Republica Argentina, etc., por Florentino Ameghino. Tomo VI., Actos de la Academia Nacional de Ciencias de la Republica Argentina en Cordoba. Buenos Ayres, 1889. Folio, pp. 1027, with Atlas.

The most important results achieved by M. Ameghino are as follows: First, the discovery and definition of numerous marsupialoid or multituberculate forms from the Eocene of Patagonia; second, the discovery of Creodonta in the same region and horizon; third, the discovery of Edentata with enamel bands on the teeth; fourth, the definition of the suborder Litopterna, and discovery of new types; fifth, the completed definition of the order Toxodontia. To these points may be added as only second to them in importance the discovery of Eocene forms of Edentata with superior incisor teeth, and the great additions to the number of forms of Edentata, Glires, and Toxodontia.

The marsupialoid forms are of great interest. Abderites resembles the Plagiaulacidæ, while in Epanorthus we have a type which shows how the singular cutting premolar of this type or that of the Marsupialia Diprotodonta may have been derived from a primitive tuberculo-sectorial tooth. The occurrence of these forms in the Eocene of Patagonia is a fact of great significance, and M. Ameghino regards them as true Marsupialia, and the ancestors of the Diprotodonta of Australia.

The Creodonta mostly repose on the evidence of imperfect material. Some of them have a simple dentition, and much remains before their true affinities can be determined.

The suborder Litopterna deserves more detailed notice, and we give it in another place in the NATURALIST. It is a most interesting modification of the Condylarthra, showing variations in dental and foot structure parallel with those seen in the Perissodactyla, with which I think M. Ameghino wrongly combines them.

The light thrown on the structure of the Toxodontia is most important. The structure of the posterior feet has been hitherto but partially known, and that of the fore feet entirely unknown. M. Ameghino shows that the former are taxeopodous, and the latter amblypodous, proving conclusively the claim of the Toxodontia to be regarded as a distinct order of ungulate Mammalia. An important feature of this book is the number of new genera allied to Mesotherium which are described and figured.

The great number of Glires described is remarkable. It is interesting to observe that they correspond with existing forms of South America, the Chinchillidæ and Caviidæ being most numerous, even in Eocene times, while the Leporidæ are very few, and present only in the latest beds.

As a general result of M. Ameghino's work it is now possible to announce the following conclusions: The extinct Mammalia may be

referred to three categories; first, the orders which have been mainly restricted to the Southern Hemisphere, and have originated there,—the Edentata, the Toxodonta, the Litopterna; second, cosmopolitan orders,—Glires, Chiroptera, Marsupialia, Perissodactyla; third, orders which have come from the Northern Hemisphere at a comparatively later period of geologic time,—Carnivora, Proboscidia, and Artiodactyla. The further history of the origin of the truly Antarctic types will be awaited with the greatest interest.

An atlas of 98 plates accompanies the text. The figures have been executed under the careful eye of the author, and express the characters referred to in the text. The great expense involved in their production has made it necessary to employ some phototype process, which can not give as good artistic effects as lithography.

We congratulate M. Ameghino on the completion of this great work. We also congratulate the country which has produced it. It is works of this character which give a nation its intellectual standing in the world. Henceforth Argentina will be known to science as a country which has added one of the largest and most important contributions to its temple of life.—E. D. Cope.

Furbringer's Researches on the Morphology and Systematic of Birds.[2]—This is a work of great thoroughness in the field which it covers. It is divided into two parts, each included in a volume; the first describing the anterior limb and shoulder girdle, and the second being a comprehensive review of the characters and systematic relations of birds. In the first volume the osteology, myology, and neurology are thoroughly described, and the illustrations cover the plates at the end of the second volume. The characters of many species are for the first time described and figured. In the second volume the work already done in bird anatomy is reviewed, both zoology and paleontology being thoroughly examined. The systematic results are set forth in tables. In one of these the structural characters are tabulated. In another the divisions down to families inclusive are displayed. We give this table, exclusive of the families, as exhibiting conciscly the author's views. Two phylogenetic trees follow. On three succeeding plates three horizontal sections of these trees are given, which display the affinities of higher and lower forms in an expressive manner.

[2] Untersuchungen zur Morphologie u. Systematic der Voegel; Zugl. ein Beitr. zur Anatomie der Stütz ünd Bewegungsorganen; von Max Fürbringer. Amsterdam Zj. von Halkema, 1888; 2 vols. folio, pp. 1751.

CLASSIS AVES.

Order.	Suborder.	Genus.
I.—Subclassis SAURURÆ.		
Archornithes	Archæopterygiformes	Archæopteryges
II.—Subclassis ORNITHURÆ.		
Struthiornithes	Struthioniformes	Struthiones
Rheornithes	Rheiformes	Rheæ
Hippalectryornithes	Casuariiformes	Casuarii
	Æpyornithiformes	Æpyornithes
	Palamedeiformes.	Palamedæ
Pelargornithes	Anseriformes	Gastornithes
		Anseres
	Podicipitiformes	Enaliornithes
		Hesperornithes
		Colymbo-Podicipites
	Ciconiiformes	Phœnicopteri
		Pelargo-Herodii
		Accipitres
		Steganopodes
	Procellariiformes	Procellariæ
	Aptenodytiformes	Aptenodytes
	Ichthyornithiformes	Ichthyornithes
Chadraornithes	Charadriiformes	Laro-Limicolæ
		Parræ
		Otides
	Gruiformes	Eurypygæ
		Grues
	Ralliformes	Fulicariæ
		Hemipodii
Alectorornithes	Apterygiformes	Apteryges
	Crypturiformes	Crypturi
	Galliformes	Galli
	Columbiformes	Pterocletes
		Columbæ
	Psittaciformes	Psittaci
Coracornithes	Coccygiformes	Coccyges
		Galbulæ
	Pico-Passeriformes	Pico-Passeres
		Makrochires
		Colii
		Trogones
	Halcyoniformes	Halcyones
		Bucerotes
		Meropes
		Todi
	Coraciiformes	Coraciæ
		Caprimulgi
		Striges

The complex characters of bird affinities are well displayed in these graphic methods. It is rendered partly clear that in a great many instances nothing but actual paleontological discovery will reveal the true connections.

Dr. Fürbringer's work, besides being a treasury of bird anatomy and character, introduces us to the literature in a most exhaustive way. Nothing has escaped him. We seem to be in the presence of all the workers who have contributed to the systematic of birds from the beginning. All are recognized, and the share of each in the work is duly recorded. As a standard of information on scientific ornithology the book will always hold a first rank.

Miller's North American Geology and Paleontology.[3]—This work is an alphabetically arranged index of the genera and species of Paleozoic plants and animals. The only scientific division of the catalogue is that into classes. The names of the genera and species are accompanied by one reference to a description, and frequently by a good figure. The work opens by a general geologic description, including the Mesozoic and Cenozoic formations, and by an enumeration of the rules of nomenclature.

The work is an exceedingly useful one for reference. The alphabetic arrangement makes it necessary that one should know beforehand what he wants to find. It is hence useful chiefly to the scientist. For the purposes of the student such a work should be systematically arranged throughout.

Some fault may be found with the description of the Cenozoic beds of the interior of the continent in a few particulars. Thus it is stated that the Wind River beds are Miocene, when they are Eocene, and the Loup Fork beds are said to be Pliocene, when they are Upper Miocene. Miocene and Pliocene pass into each other so completely, however, that the names should be abolished, and the word Neocene used in their stead. We only notice one serious objection to the systematic presentation of the subiect, and that is in the land Vertebrata. Here the Batrachia and Reptilia are mixed together under the head of Batrachia, an error for which it is difficult to account, since the distinction between the two classes has been maintained by the describers of their respective contents. In the matter of etymology of names, the present work is mainly up to the requirements of the subject. The book is one which the working paleontologist cannot do without.

[3] North American Geology and Paleontology, for the Use of Amateur Students and Scientists. By S. A. Miller. Cincinnati, 1889, pp. 664, 8vo.

Bergen's Primer of Darwinism.[4]—This little book is a convenient one to put into the hands of a preliminary inquirer on the subject of evolution. It takes up successively the variability of species, the systematic order, and the parallels between the ontogeny and phylogeny. A number of illustrations elucidate the subject-matter. The authors have not gone into the discussion of the origin of variation, and of the Neolamarckian and Neodarwinian schools, nor into the question of inheritance of acquired characters. As far as it goes, the book is an excellent one.

Morris on Civilization.[5]—The history of civilization is the history of mankind written from the utilitarian standpoint, rather than from the heroic or romantic. It is the real history, the one which will take the place of all others in our institutions of learning when our teachers have sufficiently escaped from tradition and custom. History as now taught is largely political history, where the occupations of the great majority of mankind are neglected, and in which the deeds of mankind which were best worth doing are unrecorded. Mr. Morris's book is a comprehensive synopsis of the progress of man in all his activities, occupying twenty-four chapters. He treats of population, government, religion, law, philosophy, commerce, wealth, science, art, and education. The erudition necessary for the production of such a work is encyclopædic, and we may say that the work is well done considering the limited space at the author's disposal. His own views are in touch with modern humanitarianism and modern thought, and his unobtrusive presentation of them appears to be the natural outcome of the logic of each subject as it arises. A more definite reference to authorities would have added greatly to the value of the work.

[4] A Primer of Darwinism and Organic Evolution. By J. Y. Bergen, Jr., and Fanny D. Bergen. Boston, 1890, Lee & Shepard. 8vo. pp. 260.

[5] Civilization: A Historical Review of its Elements. By Charles Morris. Chicago, 1890, S. C. Griggs & Co. 8vo, 2 vols., pp. 1000.

General Notes.

GEOGRAPHY AND TRAVEL.

A Visit to the Philippine Islands of Masbate and Marinduque.—On the first of May, 1888, after a month's stay in the Eastern Philippines, we sailed from the port of Catbalogan, in the island of Samar, bound for the island of Masbate. Our vessel was a stout little brig called the "Salvamiento," built in the islands, manned by a crew of Indians, and commanded by a Spanish captain. Our cargo was abaca (manila hemp), for the Manila market, and our only fellow-passenger was an old Indian sergeant going up to Manila on furlough. The southeast trades were just beginning to blow, and we set sail at sundown. The month in the eastern islands had been one of the hardest we had passed, with the jealousy of the authorities, poor food, the beginning of the rainy season, and a most difficult and mountainous country to hunt over, and we were pleased enough to be once more turned towards the north and home. The evening was pleasant, and we sat in the moonlight on the deck far into the night listening to the old sergeant's stories, and then turned in to sleep in a shake-down of sails on the cabin floor.

The next morning found us still moving leisurely along under the same gentle breeze, and in the common highway from the Eastern and Central Philippines towards Manila. Islands were in sight on both sides all day, most of them more or less cultivated. In the afternoon we reached the southern point of Masbate, and sailed along the eastern shore. The country looked bare and brown enough. Most of it was campo, a rolling prairie, covered with coarse grass, now parched with drouth, and in many places blackened with fire.

Just at night we turned into the little harbor of Palanoc and dropped anchor, the captain saying that he would wait and put us ashore in the morning, so that we might have time to hunt a house to stop in. He then took me ashore in his boat, and we climbed the steep bank of sixty or eighty feet, up to the little town, and there, guided by the moonlight, along a little crooked street to a low shop kept by a Chinaman, in which were an antiquated billiard table and a bar, and where were assembled the four or five Spaniards who made up the official corps of the island; for Masbate is a province, and Palanoc its capital. The captain introduced me as "Un señor naturalista Americano,"

and an old, grizzled officer in half-military dress began to tell remarkable stories of a young American naturalist whom he knew in the islands many years before. I finally made out to recognize myself in one of these stories, and the old man as an officer whom I had met and stopped with in the island of Basilan in "'74." He was acting governor of Masbate now, and the next morning put the whole establishment at our service. We were too many to accept his hospitality, and he ordered the school-house, which was closed for a vacation, to be put at our disposal. The palm thatch was in bad repair, but we had left the oncoming rainy season behind at our last stopping place, and the tables and benches served us well for our work. Several prisoners in chains were sent to transport our baggage up the steep hill, and we moved in immediately and got over breakfast in our new home while the "Salvamiento" was slowly making her way out of the harbor. The same day several of our party got out to some patches of woods not far away, and found the country so dry that great cracks ran through the soil in every direction. Birds of several kinds, especially parrots and cockatoos, were abundant. All the birds brought in had a familiar look, and the next day the same; and there was now no doubt of it, we had struck another island of the central group, and the birds were identical with those of Panay and Negros. Masbate is distant enough from these to have a fauna of its own, but a study of the sea-bottom will probably show shallows which have not long ago connected it with the other central islands. After we had spent four or five days at Palanoc, and just as we were planning a trip into a wilder and better-timbered part of the island, the steamer "Taal" came into the harbor, and began loading with cattle for Manila. We found she would touch at Marinduque, our next stopping place, on her way, and, after a hurried consultation, concluding we could add but little of value to our collections from Masbate, we packed our goods and got on board the same evening, some of the woodsmen bringing us a few fine tree snails while we were on our way to the steamer. The species of land and tree snails of the Philippines are more restricted in distribution than even the short-winged birds.

The next morning found us well on our way, and passing through a multitude of islands, several of them of considerable size and importance. The southeastern extremity of Luzon was also in sight, and the famous volcano of Albay.

We arrived at the port or roadstead of Boac, in the island of Marinduque, just at night again, and we and our baggage were set ashore just before dark. The town was several miles away, but a few houses,

forming a little fishing village along the road leading up to it, were the sight among cocoa groves. The inhabitants of the place were an inhospitable lot, and, failing to make terms with them, we camped for the night on the beach, among our baggage. The next morning, concluding the port to be better fitted for our purpose than the inland town, we hired a little house just big enough to put a table into and to hang up our hammocks, and moved in, and, hiring an Indian boy as cook, were ready to look about us. The country along the coast was level and sandy, and much of it planted in cocoa groves, the rest showing ditches and banks made for irrigating rice, though the fields were now dry and grown up to grass and weeds, the last year having been too dry to raise rice. Troops of horses were feeding over these plains. Behind this level land the country rose up in low hills, which were rocky and covered with thick bushes. The only virgin forest in sight was several miles away, inland, and on steeper, higher hills.

The birds shot in the cocoa groves about us proved to be distinct, many of them, from any we had as yet procured, though we afterwards found them to be identical with those of the great island of Luzon.

There had been a gradual increase in the number of species of birds found nesting since February, but we now found nearly all species in the full tide of nesting. It seems strange that this should agree so closely with the nesting season in the north temperate regions. Bee-birds, kingfishers, cuckoos, shrikes, fruit-thrushes, orioles, fly-catchers, sun-birds, crows, starlings, pigeons, rails, herons, ducks, parrots, and cockatoos were all nesting. When the natives heard that we had cash to pay for such things, we were fairly besieged with boys and girls and women, with birds' nests and eggs, and land and tree snails. The ladder leading up to our room usually had two or three people upon it, who would hold up their collections whenever any of us came in sight. The native name of the bird was always required, and the nest with the eggs as far as possible. One day an old woman brought a basket with a number of round, white eggs, new to us. She was required to bring the nest to which the eggs belonged before being paid, but said the nest was a "pogo," and was then told to bring along the "pogo." A few days after we found that the eggs were those of the beautiful *Merops bicolor*, the prettiest of the two Philippine bee-eaters, and that they are laid in a hole in the ground, and this was the "pogo" we had demanded of the old woman.

The number of birds building nests in holes here seemed to me to be rather remarkable. Among these were the bee-eaters, kingfishers,

swallows, shrikes, two species of starlings, cockatoos, parrots, owls, woodpeckers, and hornbills. But for the help of the natives our collections would have been poor; but the island seems over-populated, at least for the methods of cultivation used, and the people were anxious to get our money. Among the animals brought us were two of the curious Philippine rats (Phlœomys). They were nearly as large as our common gray rabbit, light-gray in color, with short black tails. They were brought living, tied together to a stick, and had nearly cut each other to pieces before we received them.

A trip down the beach to the south two or three miles brought us to a small creek flowing out of the hills, and following this up we found some woodland in the steep ravines, and many birds, among them two species of beautiful pittas, in abundance, and further above, a few of the great hornbills (*Buceros hydrocorax*), and the curious crested cuckoos (Dasylophus), before supposed to be limited to Luzon. At about the same distance to the north there was a tract of lowland, much of it planted in rice, which was now being harvested, and here all kinds of waders were abundant,—rails and gallinules and herons of several species, most of them nesting, and a few Philippine mallards. Along the sea beach were thickets of small timber, and upon these we found one of the prettiest of the Philippine tree snails quite abundant, while the natives brought us from further inland quantities of *Bulimus philippenensis* and *woodianus*, two of the largest and finest species in the islands. The weather, which was dry when we arrived, gradually changed. Rain-clouds gathered over the hill-tops, and before the close of the month we had several heavy showers, and the rainy season had begun, and we prepared to move before it again,—this time to the little-known island of Mindoro, which was in sight across the strait, twelve or fifteen miles away.—J. B. STEERE, *Ann Arbor, Mich.*

GEOLOGY AND PALEONTOLOGY.

Elevation of America in the Cenozoic Periods.—Mr. W. H. Dall writes as follows to the *Geological Magazine* for May, 1891:

"I notice in recent numbers of the *Geological Magazine* that Mr. Upham has been discussing his views on the elevation of the Gulf of Mexico, etc. It seems a pity that gentlemen who desire to launch such startling hypotheses should not devote more time to settling the facts upon which these hypotheses are based before promulgating their new views. As the statements made by Mr. Upham may be taken as properly verified, and more confusion be thereby occasioned, permit me to call attention to a few facts which have been verified.

"1. The late Dr. Maack, when on the Isthmus of Darien, did not collect any Pleistocene fossils from the summit of the Atrato divide, 763 feet above the sea. 2. The Pleistocene fossils collected by Dr. Maack were from an elevation of only 150 feet on the Panama side, ten miles from Panama City. The fossils above this height collected by Dr. Maack are Eocene or Miocene exclusively, and related to the Miocene fauna of Santa Domingo, as indeed was pointed out by Gabb nearly twenty years ago (Proc. Am. Philo. Soc., Vol. XII., p. 572). 3. The summit or dividing line is not fossiliferous, and is probably not later than the Mesozoic epoch.

"I may add, from information to be shortly published, that the supposed great elevation of Florida at any time since the later Eocene is as improbable as any hypothesis which could well be conceived. The conclusions which the facts necessitate in the case of Florida may be briefly outlined as follows: During the later Eocene, West-Central Florida was an island, like one of the Bahamas at present, composed exclusively of organic marine sediments, which in the Vicksburg epoch attained an unbroken thickness of more than 1,000 feet. The whole submarine plateau above which the present Florida rises may turn out to be of this age and constitution. This island had a land-shell fauna derived from the south. The strait between the island and the main coast north of it was more than fifty miles wide at the narrowest point, and was only closed at the beginning of the Pliocene. There have been gentle changes of level since the Eocene, but nothing violent, and the vertical range has been small. The Eocene and the old Miocene faunas were of a subtropical character, like the Antillean fauna at present. A change took place in mid-Miocene by which a cool, temperate, or colder water fauna invaded the Floridan region

from the north, and about 200 feet of strata (Chesapeake Group) were deposited, equivalent to the well-known Miocene beds of Virginia and Maryland. With the elevation which connected the Floridan islands with the continent a warmer era was again inaugurated in the sea, and an invasion of Pliocene vertebrates began on the peninsula of Florida.

"There were unquestionably great changes of level on the continent, increasing as one goes northward, both in Miocene and Pleistocene times. In the Antilles it has been proved that great changes have taken place. But the Floridan region, for some unknown reason, escaped, and Yucatan probably also.

"I have been making a special study of Floridan geology for some years, and hope to publish a considerable amount of new information on that subject during the coming summer."

Discovery of Coal near Dover, England.—In the *Contemporary Review*, April, 1890, Professor W. Boyd Dawkins gives a history of the discovery of coal in Southeastern England. As far back as 1826 Buckland and Conybeare recognized the physical identity of the coal-bearing districts of Somerset on the west with those of Northern France and Belgium on the east. In 1855 Godwin-Austen showed that the general direction of the exposed coal fields in South Wales and Somersetshire and those of North France and Belgium was ruled by a series of folds running east and west parallel to a great line of disturbance centered in the "axis of Artois," and concluded, from a careful study of the region, that there are coal fields beneath the Oölitic and Cretaceous rocks in the south of England, near enough to the surface along the ridge to be capable of being worked. His views were reinforced by Prestwich, in a report made to the Coal Commission of 1866–'71. At length, in consequence of a report made by Mr. Dawkins to Sir Edward Watkin, chairman of the Southeastern Railway and the Channel Tunnel Company, a shaft was sunk on the west side of Shakespeare Cliff, near Dover, to the depth of forty-four feet, and from the bottom of this a bore-hole has been made to the depth of 1,180 feet. The Coal Measures were struck at a depth of 1,204 feet from the surface, and a seam of good blazing coal was met with twenty feet lower. This discovery establishes the fact that there is a coal field lying buried under the newer deposits of Southeastern England, and proves up to the hilt the truth of Godwin-Austen's hypothesis, after a lapse of thirty-five years.

Occurrence of Texas Lignites.—The lignites of Texas occur in the Fayette Beds and Timber Belt Beds of the Tertiary deposits. The borders of this area have been determined and have been fully described by Prof. E. T. Dumble in the Mineral Resources of the United States, 1887, since which time they have not been changed materially by the later investigations. The Fayette Beds underlie the coast clays and other Quaternary deposits of Texas. Their outcrops cross the entire State from the Sabine River to the Rio Grande, and consist of clays, sands, limestones, and pebble deposits. The underlying Timber Belt Beds are composed of siliceous sand and greensand marls, interstratified with clays, generally of a brown color, and thin beds of limestone. The beds of lignite contained in both these series of rocks are very numerous, sometimes occurring in lenticular masses, greater or less extent, thinning out in every direction, and again form extensive seams of considerable thickness, frequently fourteen feet. The Texas Tertiary has been but little disturbed. The force lifting these strata to their present level has caused a gradual and slow elevation, leaving them as originally laid down by the Tertiary sea. However, though no violent volcanic eruptions have distorted these beds, they are nevertheless found sometimes broken, faulted, and bent, caused by the drying and compression of loose, moist underlying deposits. (Second Ann. Rept. on the Iron Ore District of East Texas, 1890.)

The Geological and Natural History Survey of Minnesota.[1]—The report of the Geological and Natural History Survey of Minnesota for 1889 embodies a summary of American opinions on the older rocks of North America by Alexander Winchell, and the record of Mr. N. H. Winchell's field observations in the northeastern part of the state during 1888 and 1889. These observations confirm the views lately set forth by Irving, Bonney, and Samson, and the conclusions published by the reports of the Minnesota survey, to the effect that the Huronian system, as now defined and understood by the Canadian geological reports, really embraces two or three formations; that one of these is the true Huronian, as at first described and mapped by Murray, another is the Keewatin of Dr. A. C. Lawson, containing the iron ores at Tower, Minnesota, and another is the series of crystalline schists which have been styled Vermilion series. These three formations are distinctly separated by lithology and unconformities that have been noted from Vermont to Minnesota, and should no longer be

[1] The Eighteenth Annual Report of the Geol. and Nat. Hist. Surv. of Minnesota, for the year 1889; N. H. Winchell, director.

included under a single term,—at least not under the term Huronian, which at first had a correct and adequate definition, embracing but one of them.

This report gives an idea of the progress that is being made in the intricate geology of the northeastern part of the state, and of the economic resources that are being developed there.

Geological News—Archean.—Mr. Arthur Harvey thinks that the nodules found in the Animikie slates in the region of Thunder Bay are fossil organisms simpler in structure than sponges. In appearance they resembled the puff-balls of our meadows, varying in size from a hen's egg to a coal-scuttle. (Transactions Canadian Inst., March, 1891.)

Paleozoic.—A. Smith Woodward reports two new Devonian fishes, —*Onychodus arcticus*, from Spitzbergen (*Ann. and Mag. Nat. Hist.*, August, 1889), and *Climatius latispinosus*, from New Brunswick (*Geol. Mag.*, November, 1889).——Mr. R. B. Newton has described and figured a new mollusc (*Porcellia latidorsata*) from the Carboniferous limestone of Ireland (*Geol. Mag.*, 1891). Mr. Newton proposes to change the name of Porcellia Lev. to Leveillia, because it resembles the Porcellio of Latreille; an entirely inadmissable proposition.——E. N. Ringueberg has described and figured five new crinoids from the Lower Niagara limestone at Lockport, N. Y. *Callicrinus acanthinus*, *Glyplaster* (*Eucrinus*) *lockportensis*, *Ichthyocrinus conoidens*, *Eucalyptocrinus muralis*. (Annals N. Y. Acad. Sci., July, 1890.)

Mesozoic.—According to A. Smith Woodward, the so-called Creaceous lizard, Raphiosaurus, is founded upon the anterior half of the dentary bone of a characteristic Cretaceous fish, Pachyrhizodus. (*Ann. and Mag. Nat. Hist.*, November, 1889.)——Mr. David White has found Cretacic plants at several points about Gay's Head at Martha's Vineyard. They seem to be nearly related to those of the Middle Cretacic of Greenland, and there is reason to believe them identical with the flora of the Amboy clays. (Bull. Geol. Soc. Am., Vol. I., p. 554.)——Mr. R. T. Hill divides the Comanche series of Texas into several separate and distinct terranes, the lower two of which may possibly be of the pre-Cretaceous age. He gives both stratigraphic and paleontologic proof that such a division is neccessary. (Bull. Geol. Soc. Am., Vol. II. pp. 503–528.)——A new genus of Paleoniscid fishes from the Karoo formation of South Africa has been described by A. Smith Woodward under the name of *Atherstonia scutata*. In appearance of the scales, the situation and proportions of the fins, this

South African fish most nearly approaches Gyrolepis, from the European Trias and Rhætic, and Rhabdolepis, from the European Lower Permian. (*Ann. and Mag. Nat. Hist.*, September, 1889.)

Cenozoic.—Mr. Sirodont has been studying the fauna of a Cenozoic formation at the foot of Mount Dol, on the southeastern side. He is of the opinion that the débris there accumulated belongs to a period anterior to the movement which elevated the shores of certain regions about the Baltic Sea. (*Revue Sci.*, June, 1891.)——Mr. E. Riviere reports the finding of the teeth and bones of *Equus caballus fossilis*, *Bos primigenius*, and a deer as yet undetermined, in the sands of Cergy. (*Revue Sci.*, May, 1891.)——Dr. Reusch has found glacial striæ and boulder clay in Finmark, belonging to a period much older than the "ice age." The ice-marked sandstones are probably Permian, but may belong to the Cambro-Silurian series. (*Geol. Mag.*, May, 1891.)

General.—M. L. Cayeux announces the discovery of an important formation of Diatoms in the tufa which contains *Cyprina planata* in the north of France and Belgium. This tufa results from the agglomeration of sands of the same horizon cemented together by a colloidal or chalcedonis silex. Among the Diatoms which are thus found in great numbers the author cites Synedra, Triceratium, and Coscinodiscus. (*Revue Sci.*, May, 1891.)——Mr. A. Lindenkohl reports a sunken river channel in Chesapeake Bay. A narrow and deep channel can be traced nearly throughout the entire length of the bay, from the mouth of Bush River to that of the Rappahannock, a distance of 120 miles. (*Am. Jour. Science*, June, 1891.)——On his return from Koukou-nor, while crossing the Nau-Chang, Mr. Martin discovered a large band of Jade encased in a rather friable rock. It is true Jade, as fine as that of Siberia, and is worked by the natives to make ornaments, often of great value, for the Chinese. (*Revue Sci.*, May, 1891.)——As to glacial records in the Newark system, Mr. I. C. Russell says that after personally examining nearly every area occupied by it, he fails to find any evidence to support the hypothesis that glaciers assisted in its deposition. (*Am. Journ. Science*, June, 1891.)

ZOOLOGY.

Abnormal Duplication of Urosome in Rana catesbiana.—While searching the stores where aquatic supplies are sold it has been my fortune to obtain two tadpole monstrosities,—one from a dealer in Harlem, and one from a store near Cooper Union, New York city. The occurrence of two such specimens during the same season, each obtained from a different locality, sets aside the probability of either being the result of accident. A careful examination has led to the conclusion that the malformations are congenital. As I am assured by Dr. John A. Ryder that nothing of the sort has been observed hitherto, I furnish herewith a description and sketch, as being of possible interest in their bearings on the morphology of monsters.

Both are tadpoles of *Rana catesbiana*, far enough advanced to possess the posterior limbs. These, however, have very small thighs, and pre-

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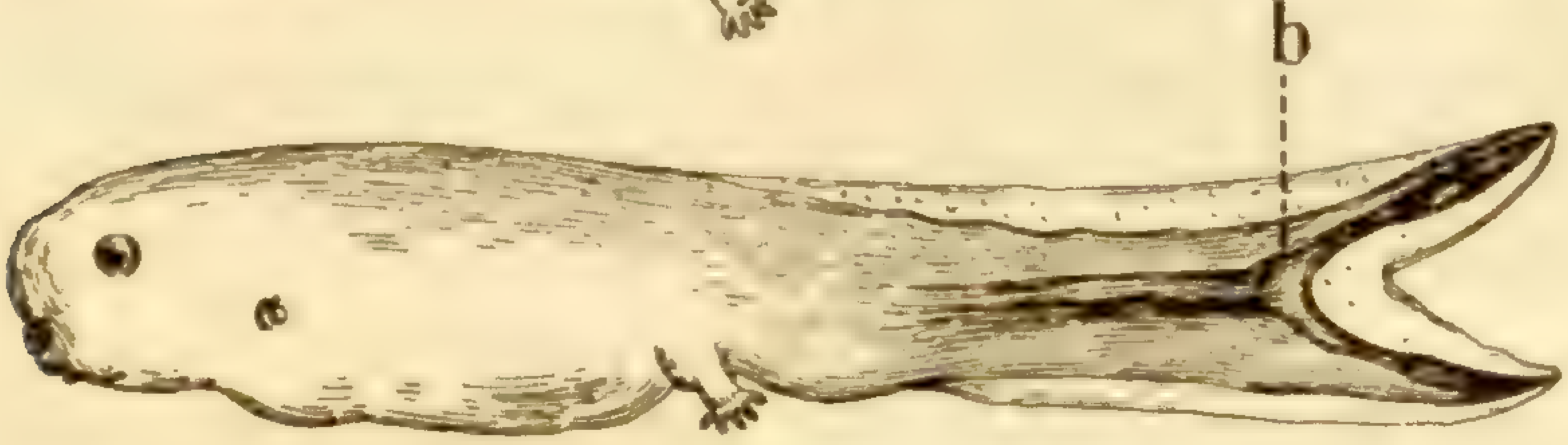

sent a dwarfed appearance as compared with those of normal tadpoles of same size. One of the tadpoles died soon after coming into my possession; the other is alive. In both the abdomen is oval and flat, instead of swollen and globular. This characteristic has been persistent with the tadpole now alive, although it has been furnished with Anacharis, Utricularia, and other food-plants, and has fed upon them constantly with as much zest as is shown by ordinary tadpoles. In the tail of each a bifurcation takes place toward the tip, and there follows a duplication of the tail above and below the axis of the body. In both the dorsal and ventral branches of the fin-fold occurs a series of muscle-plates, and a dorsal and ventral branch of the chorda corresponding to the diverging limbs of the tail-tip. The plates extend a little beyond the point of bifurcation, and the notochord to the

extreme tip of each branch. In each three vein-like structures extend to the tips of branches, which I suppose to be the spinal cord, aorta, and caudal vein; but, as neither specimen has been dissected, and these structures are not very clearly defined, this point must rest in doubt.

The lines which cross near bifurcation appear to do so in each specimen, a dorsal branch of chorda passing into ventral, and a ventral branch into the dorsal fin-fold.

So far as known, all duplications of this kind have been to the right and left of a median line, as in Japanese goldfishes, and *this vertical duplication, with the result of appending to an ordinary tadpole a structure closely resembling the forked caudal fin of some fishes*, may suggest one of the methods of evolution of fishes and frogs from the same ancestral vertebrate form.

I should be pleased to correspond with any one interested, and to communicate further if other facts can be obtained by a closer examination of this exceedingly rare and unusual larval form.

[NOTE.—These cases of abnormal tadpoles described by Mr. Sherwood have seemed to me so remarkable that it appeared very desirable that they should be figured. The method of duplication of the tail is precisely the reverse of that observed in the case of the so-called "fan-tail" races or double-tailed goldfishes from Japan and China. What disturbances of ontogenetic processes may have led to the development of this singular form of monstrosity in the tails of tadpoles remains to made out. The origin of such irregularities may be coupled with actual mutilations, as seems to be indicated in other cases, by the experiment of cutting off the tails of tadpoles, as described in the *Archiv f. mik. Anatomie*, 1891 (D. Barfurth on functional adaptation and the regeneration of tissues in the Amphibia). In the memoir referred to it was found that the angle, with reference to the notochordal axis, at which the tip of the tail of a tadpole was cut off determined the direction of the inclination, upwards or downwards, of the tip of the tail, which was reproduced. If the tail was cut square across or at right angles, there was no departure from the normal form of the reproduced tip. If, however, the tip of a tadpole's tail was cut off so that the upper half of the plane of section, or that above the notochord, formed an acute angle with the latter (the angle opening forwards), the now newly reproduced tip of the tail would have its axis directed upwards. If the lower half of the plane of section formed an acute angle with the notochordal axis (the angle opening forwards), the tip of the tail which would now be reproduced

from the stump at the plane of section would be directed downwards instead of upwards, as before. In other words, the direction of the plane of section in these cases of the mutiliation of tadpole's tails determined the direction of the axis of the finally completed and restored tails.—J. A. R.]

Snakes in Banana Bunches.—Since the notices published on this subject in the NATURALIST (1890, Aug. and Oct., p. 968) three other instances have come under my notice. Prof. J. Lindahl, of Springfield, obtained from a fruit dealer in Chicago a specimen of the harmless dipsadine snake, *Sibon annulatum* Linn., which he obtained from a bunch of bananas. Wm. Cherrie, of San José, Costa Rica, informs me that as many as six men were killed during 1890 by the bites of a venomous snake which lives in the banana bunches, which they load on vessels at the port of Limon on the Caribbean Sea. From figures and descriptions Mr. Cherrie recognizes the species to be the *Telesuraspis schlegelii* Berth., which abounds in Costa Rica. It has the prehensile habit fully as well developed as in the Boidæ, which have been found in the like situation. The Philadelphia Zoological Garden has received a specimen of a small boa, the *Ungualia pardalis*, which was taken from a banana bunch from Jamaica. The list of banana-dwelling snakes now includes five species,—viz., three boas, one harmless colubrine snake, and one venomous species allied to the copperhead.—E. D. COPE.

Description of a New Jumping Mouse from Nova Scotia and New Brunswick.—But one species of Zapus has been recognized by recent writers on North American Mammalogy, hence it was with much interest that I examined three specimens taken at Restigouche, N. B., during the summer of 1880, by Mr. E. A. Bangs, of Boston, who recently sent me the skins for determination, saying that he had always considered them different from the animal found in Massachusetts. The mice were collected on the banks of a river in the depths of the forest, and were very difficult to procure, as they could not be induced to enter any kind of a trap, and it was necessary to shoot all the specimens taken. About half a dozen skins were obtained, all but three of which were subsequently destroyed by insects. These three specimens represent a species evidently distinct from *Zapus hudsonius*, and may be named and characterized as follows:

ZAPUS INSIGNIS, sp. nov.—*Meriones labradorius* Dawson, *Edinb. N. Phil. Journ.*, III., January, 1856, 2, not of Richardson and Sabine.

Sp. ch.—Size and color about as in *Zapus hudsonius*, from New

York and Massachusetts; tail slightly longer proportionally, white all around for about 25 mm. at tip. Length 225, tail 126, hind foot 30 mm. (Type ♀ ad.; No. $\frac{464}{887}$, collection of G. S. Miller, Jr., Restigouche, N. B.; September 10th, 1880; E. A. Bangs, collector.) The skull closely resembles that of *Z. hudsonius*, but is slightly larger, with brain-case a trifle broader and flatter.

The other two specimens are males. They agree perfectly with the type, except that the tails are longer, with the white tips reduced to 13 and 11.5 mm. They measure: Length 224, tail 141, hind foot 30.8; and length 235, tail 140, hind foot 30.4; and were taken at Restigouche, September 8th and 10th, respectively.

The three specimens agree in lacking the upper premolar usually usually found in *Zapus hudsonius*; but as all are old, and have the teeth much worn, it is possible that this tooth may have been shed, leaving no trace of its former presence. I can find no published account of the occasional absence of this premolar in *Z. hudsonius*; but Mr. F. W. True writes me that a single specimen from Pennsylvania in the U. S. National Museum shows this peculiarity.

Apparently the only description of a jumping mouse with white-tipped tail is that given by Dawson (*Edinb. N. Phil. Journ.*, III., 1856, 2), who describes the animal from near Halifax, and uses the name *Meriones labradorius* Rich. for it. Richardson took his name from Sabine (*Zool. App. Franklin's Journ.*, 1823, 661), whose specimen "from Cumberland House" was imperfect, having the tail only 2.50 inches long, thus rendering the name *labradorius* undeterminable. The first adequate description given under the name *labradorius* is that of Richardson, in the "Fauna Boreali-Americana," and this refers strictly to *Z. hudsonius*, or at least to a dark-tailed animal.

My warmest thanks are due Mr. Bangs for his kindness in permitting me to announce this new species, which is his discovery rather than my own.—GERRIT S. MILLER, JR., *Peterboro, N. Y., June 28th, 1891.*

Descriptions of Three New Species of Mexican Bats.—During a recent collecting trip, made for the Comision Geografica-Exploradora, to Las Vegas, Canton of Jalapa, Vera Cruz, I found what appears to be a new species of Vesperugo.

Close by the hamlet of Las Vegas is a small, long-since-extinct volcano, on the sides of which are found numerous "sink-holes" that give entrance into long, narrow caves or tunnels, through which formerly flowed the lava after it had ceased to be fluid on the surface. Some of these tunnels are as smooth and clean as though but lately emptied of their fiery contents, whilst others are strewn with great

heaps of angular fragments of lava, jarred down from the roof by some earthquake. Not infrequently two or three superimposed tunnels have been united in parts of their length by their respective floors having fallen through. In these caves, even on the hottest day, the air is fresh and cool, and has a perceptible current down the mountain side, which at the constrictions becomes a strong breeze. This coolness of the atmosphere was a fortunate circumstance for my collecting, as because of it I found most of the bats in a state of semi-hibernation, enabling me to take with the hand all those within arm's reach. Prof. J. A. Allen's recently described *Vespertilio velifer* was the prevailing species, abounding in hundreds, and of which I took with the aid of my assistant, Señor Carlos M. Teran, 193 specimens; 151 being males, and the remaining 42 females. This I take to be a fair average of the proportion of the sexes in what is probably one of their permanent headquarters. *Plecotus macrotis* was scattered about in very sparing numbers, but five specimens being seen. Unlike my former experience with this species in the valley of Mexico, all were found solitary, completely isolated from the other species as well as from one another.

While collecting these bats I came across one whose small size immediately distinguished it from the two other species; yet from its general similarity in form, viewed by the uncertain light of a stearine candle, and its almost exact identity in color with *velifer*, led me for the moment to suppose that it was a young of that species. But upon finding another of these small bats I made a closer examination, and at once saw that I had another species to deal with, new to me, and I fancied new to science. A search through all the literature of the subject that I have at hand confirms me in the belief that it is an undescribed species.

Six specimens, five males and one female, were taken, and no others were seen. In every case they were hanging from the sides of the caves, instead of from the roofs, as was the case with *velifer*, and unlike it were always solitary,—a point on which I place no special stress, as I find this and several other habits of bats to vary with locality, etc. Some were taken not far from the entrances, where, when the eyes were accustomed to the darkness, a faint sort of phosphorescent glow could be seen in the direction of the mouth of the cave. Others were taken many hundreds of yards within, where intervening abrupt angles rendered it absolutely impossible that the slightest ray of light could at any time of day penetrate. That this locality is not the headquarters of this species I am satisfied; whether higher up in the *tierra templada*, or below in *tierra caliente*, will prove to be its

center of distribution I am not positive ; but I think that it will be in *tierra caliente*, at least during the winter months. The semi-hibernation of the specimens taken point toward this opinion, for I am inclined to believe that here, where ten miles of travel may bring an entire change of climate, the bats, as a rule, prefer to migrate rather than to hibernate.

These bats, when first taken, were entirely motionless ; but in a few moments the heat of my hand revived them, whereupon they occasionally gave voice to a faint, high-pitched squeak,—so high in pitch that I fancy it lacked little of being beyond the range of the ordinary human ear. They went into none of those ecstasies of rage seen in many of the larger species that bite whatever comes within range of their mouth, be it their own foot or wing. One, found in a comparatively dry part of a cave, was completely beaded over with dew, indicating, I think, that it had passed at least several days since taking flight. When taken into the daylight they closed their eyes and covered them over with the carpal portion of their wings.

VESPERUGO VERÆCRUCIS, sp. nov.—All six specimens were indistinguishable one from another in point of color. The following color-description is taken from a dried skin, whereas all the rest of the description is taken from a specimen preserved in alcohol.

Fig. 1.

Fig. 2.

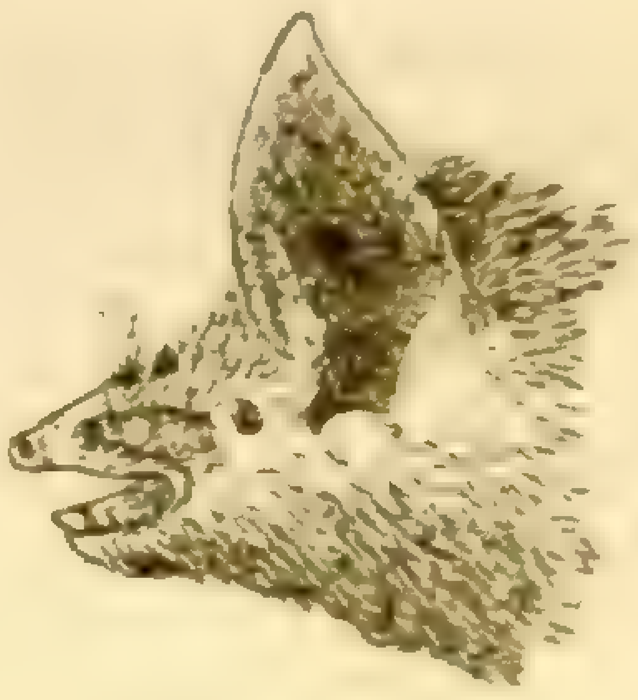
Fig. 3

Vesperugo verœcrucis.

Hairs of back clove-brown for basal half, followed by two equal zones respectively broccoli-brown and clove-brown ; some of hairs furthermore tipped with light Vandyke-brown, giving a decidedly "rusty" tone to the back. Ventral surface, bases of hairs slightly lighter than those of back, followed by light hair-brown, producing a grayish or smoky effect.

Wing membranes naked, except a very limited area on upper surface along sides of body, not exceeding three or four millimeters in width ; and on lower surface, the area included between a line passing from

the middle of humerus to the knee and the side of the body is scantily haired.

Interfemoral membrane with a small, triangular patch of hair on its upper surface, covering base of tail, and extending to one-fourth of its length.

Legs and arms naked. Wing extending from base of outer toe. Antebranchial membrane losing itself at middle of radius. Two caudal vertebræ free from membrane.

Black glandular prominences between eyes and nostrils well developed, fringed with longish hairs on both upper and lower edges, and with three or four long, black, bristly hairs growing from its upper surface.

Inner edge of ear conch evenly convex. Outer edge coming up, in an even, sweeping curve, from angle of mouth to level of tip of tragus, where it meets a slightly concave line leading up to the obtusely rounded tip. A nearly semi-circular antitragus is developed from that part of the conch passing below the tragus. Bone of inner margin of tragus concave, thus throwing this organ forward, followed by a straight margin. Bone of outer margin with a sub-triangular lobe, followed by a deep notch, above which the greatest width is quickly reached. From here a nearly straight line leads to the tip, which is obtusely rounded. (See Fig. 2.)

Measurements in millimeters: Length of head and body, from tip of nose to base of tail, 37.5; length of tail, 36; length of tail beyond membrane, 3; length of head, 15; height of ear, from notch between antitragus and conch to tip, 10; height of tragus, inner margin, 4.5; height of tragus, outer margin, 6; greatest width of tragus, 2; length of antitragus, 2; height of antitragus (approximately), .75; length of forearm, 31; length of thumb, including claw and excluding metacarpus, 7.5. Second digit—metacarpal, 29. Third digit—metacarpal, 30.5; first phalanx, 11.5; second phalanx, 11; cartilaginous tip, 5. Fourth digit—metacarpal, 29; first phalanx, 10; second phalanx, 7; cartilaginous tip, 2.5. Fifth digit—metacarpal, 28; first phalanx, 8.5; second phalanx, 5; cartilaginous tip, 1. Interspace between tips of third and fourth digits, 16; interspace between tips of fourth and fifth digits, 37; interspace between tip of fifth digit and juncture of membrane with foot, 42; extent of outstretched wings, 212; length of tibia, 13.5; length of foot, 9; length of calcaneum, about 8.

Teeth $\frac{2-2}{3-3}\ \frac{1-1}{1-1}\ \frac{2-2}{2-2}\ \frac{3-3}{3-3} = 30.$

Middle upper incisors separated by 1.5 mm., inclined forwards and inwards; a large internal cusp on posterior-external edge halfway up

from base to tip. Outer incisors simple, conical, inclined parallel to their respective inner mates, separated from canines by about .75 mm. Lower incisors tri-lobate, evenly spaced. Upper canines long, simple, slightly recurved. Lower canines straight, with basal cusps on forward edge only. First upper premolar interior to tooth line, visible from the exterior. Second upper premolar longer than any of its corresponding molars.

A prominent conical excrescence is on the lower gum, opposite the space between the premolars, in front of which the point of the upper canine passes. Two much less prominent excrescences are on the upper gum immediately above this lower one. Type No. 527 ♂, Las Vegas, Vz., Feb. 19, 1891. Collectors, H. L. Ward and C. M. Teran.

Vesperugo verœcrucis appears to be most closely related to *V. georgianus;* therefore I append a comparative table of measurements:

V. verœcrucis.	Tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of third finger.	Expanse.	
527. ♂	37.5	36.	31.	13.5	56.	212.	Alcoholic specimens in the Museum of the Comision Geografico-Exploradora.
528. ♀	38.5	36.	32.	14.	55.	215.	
529. ♂	37.	34.	30.	13.	52.	210.	
530. ♂	34.	32.	30.	14.	51.	207.	
531. ♂	38.	34.5	30.5	13.5	54.	210.	
V. georgianus.							Extremes of measurements of ten alcoholic specimens of U. S. Natl. Mus., taken from H. Allen's Mon. N. A. Bats, p. 37, and reduced to millimeters.
Largest individual measurement,	46.	41.	36.	18.	61.	237.	
Smallest individual measurement,	41.	38.5	33.5	15.5	56.	219.	

From this table we see that, with but a single exception,—*i.e.*, third finger,—the smallest measurements given by Dr. Allen of *georgianus* exceed the largest measurements of *verœcrucis*. Were this the only difference found, I should probably consider my specimens as representing a smaller southern variety; but taken in consideration with difference of color pattern, the dorsal hairs having three and some even four distinct bands of color, instead of but two, as *georgianus* is described, the nakedness of the legs, less extent of hair on interfemoral membranes, etc., an apparent difference in the form of the ear, and slight differences in the teeth, lead me to also consider this difference in size as a characteristic of the species.

Nyctinomus depressus, sp. nov.—For about a year I have been aware of the existence in this museum of an apparently undescribed species of Nyctinomus, an adult male taken within the museum building. I have vainly endeavored to obtain other specimens of this species, but

have so far found no other of the genus except *brasiliensis*, which is extremely numerous here, as well as in several other parts of the country where I have collected.

The specimen under consideration appears to be more closely allied to *N. macrotis* than to any other described species, but quite distinct from this, as will appear by a comparison of the figures and description here given with Dobson, Catl. Chiroptera in Brit. Mus., pp. 435, 436, Pl. XXII., Fig. 6.

Above, burnt umber; below, Prout's brown; bases of hairs on both surfaces, white. Membranes and ears, in the alcoholic specimen, nearly perfectly concolor with the under surface of body. A line of

Fig. 4

Fig. 5.

Nyctinomus depressus.

very short hairs bordering humerus and radius on upper surface of antebranchial membrane, so fine as scarcely to be perceptible when wet. On upper surface of wing membrane, short lines border the radius, except at the extreme elbow, and occupy the angle formed by the juncture of the fourth and fifth metacarpals. On both upper and lower surfaces the membrane is covered with hairs to a line extending from the proximal third of humerus to the middle of the femur. Interfemoral membrane covered for three or four millimeters below femora on upper surface, and naked on lower. Inner edge of ear evenly convex when flattened out, but from its vertical waviness appearing as in Fig. 5. The forward interior margin is reflexed over the deep depression at the upper extremity of the keel, thus forming a sort of pocket. Outer margin bilobate, the lower lobe arising from a short, straight base coming up from behind the antitragus, the upper lobe being continuous with the tip and inner edge. Keel large, strongly reflexed at angle near base, extending slightly exterior to the antitragus. Tragus straight on inner and upper margins. Outer margin formed by two slightly concave lines producing a slight lobe by their juncture at

the center of this margin. Conch with seven diagonally transverse flutings appearing as furrows on the upper and as ridges on the lower surface, the posterior one being very slightly marked. On the outer surface, passing through the centers of these flutings, and at right angles to them, is a slight ridge formed by a doubling of the skin. The peculiar depressed angle formed by the juncture of the two lobes of the external margin of the conch (*vide* Fig. 4) gives to the ears of this species a peculiar drooping appearance that has suggested to me *depressus* as a fitting specific name.

Nostrils circular, opening forwards, outwards, and very slightly downwards. A prominent subcircular swelling between the eye and nostril and slightly below a line connecting them. Side of face with five flutings extending to lip. A deep furrow under eye. Face and chin nearly naked. Wing membranes from inner surface of distal ends of tibia and from calcanea, indefinitely edged with yellowish-white, more defined in centers of interdigital spaces and in center of the space between the fifth finger and tibia. Outer edges of first and fifth toes closely fringed with short, curved white hairs; on the fifth toes, dorsal to this outer fringe, is a row of less numerous curved hairs, exceeding them about three times in length. From the upper surface of base of each claw spring three or four long curved hairs, about 8 mm. in length on chord. No gular pouch. Thumb with well-developed callosity at base of first phalanx.

Teeth $\frac{1-1}{2-2}\ \frac{2-2}{1-1}\ \frac{2-2}{2-2}\ \frac{3-3}{3-3} = 30.$

Upper incisors semi-conical, parallel, separated by space of 1 mm. Lower incisors bifid, crowded; the middle pair in a straight line, the outer ones starting from near centers of inner surfaces of middle pair and diverging at an angle of 45° from them. Canines long, with distinct, unbroken anguli, somewhat dilated on posterior-internal part of lower one, but not forming a true cusp. The upper canines are curved backwards, saber-shaped, passing 1.5 mm. below gums of lower teeth when the mouth is closed, the lower pair fitting into sockets between upper incisors and canines. First upper and lower premolars much smaller than second ones, in middle of spaces between these and canines. Second upper premolars decidedly longer than molars, with very acute outer cusps; the internal cusps not particularly developed, as is the case with *macrotis*.

Measurements in millimeters from alcoholic specimen: Length of head and body, from tip of nose to base of tail, 79; length of tail, 52; length of tail beyond interfemoral membrane, 33; length of

head, 31; length of ear, from notch between antitragus and conch to anterior point of margin, 25; length of antitragus, 7; height of antitragus, 4.5; height of tragus at inner border, 2.5; height of tragus at outer border, 4.5; width of tragus at top, 2.5; ears unite at base for 3.5; length of forearm, 60; length of thumb, not including metacarpal, 8. Second digit—metacarpal, 55. Third digit—metacarpal, 58; first phalanx, 24; second phalanx, 22; cartilaginous tip, 7. Fourth digit—metacarpal, 56; first phalanx, 21; second phalanx, 2. Fifth digit—metacarpal, 29; first phalanx, 20; second phalanx, 5. Interspace between tips of third and fourth digits, 31; interspace between tips of fourth and fifth digits, 60; interspace between tip of fifth finger and attachment of membrane to tibia, 60; extent of outstretched wings, 357; length of tibia, 18; length of foot, 13; length of calcaneum (poorly defined), about 16.

Type, and only specimen, No. 516 ♂ ad. Tacubaya, D. F., Mar., 1887. Collector, Louis G. Ruòz.

A comparison of the measurements of this species with *macrotis* shows that although the length of ear, forearm, and peculiarly short second phalanx of the fourth digit are the same in the two species, yet *depressus* is considerably the larger bat of the two.

CENTURIO MINOR, sp. nov.—I have in hand an adult female Centurio that I cannot identify with either *C. senex* or *m'murtrii*, because of some apparent differences in the cutaneous folds of the chin, and because of differences in measurements that I cannot believe to be due to individual variation. Unfortunately the collector commenced to make a skin of the specimen, dissecting the head to forward of the eyes, before deciding to preserve it in alcohol. For this reason I give only a figure of the lower jaw, for I know by experience that at best I could make but a guess at what was the original shape of the head. Fortunately the specimen has never been permitted to dry, so that the cutaneous folds and ears are in their normal condition.

Fig 6.
Centurio minor.

The specimen contained a (about half-ripe) fœtus that is preserved entire, and that shows all the cutaneous folds of the adult, and besides possesses a curious cone of skin springing from the occiput, looking like the top-knot of hair of *macmurtrii* as figured in the Biologia Centrali-Americana.

Description of type, No. 525 female ad, Cerro de los Pajaros, Las Vegas, Vz., July or August, 1888. Collector Carlos M. Teran.

Color, above Brocolli-brown, lighter on occiput and neck, darker toward the tail. Each hair three-zoned; base brown, middle white,

and tip brown ; the white occupying one-half of entire length. On the lower part of back the white becomes more and more soiled until it is scarely noticeable. Or the hairs may be described as brown on lower back, with slightly lighter centers that fade to pure white on neck, and occiput. Belly same as back, becoming lighter on head and neck, which is white, washed with brown. No distinct zones of color as on dorsal surface. At ventral aspect of junction of antebranchial membrane with the body is a small, triangular spot of white fur. Wing membrane externally covered with unicoled hairs, same shade as dorsum, to line from middle of humerus to near knee. Upper surface of interfemoral membrane thinly clothed, same color as rump. Wing membranes from tarsi. Antebranchial from bases of first phalanges of thumbs. Face naked, with the exception of a few white bristles and a row of short white hairs from corner of mouth to antitragi. Lower jaw naked in front, bordered by a fold of skin, free in central part that passes from antitragus to antitragus. Another narrower fold leaves this at corners of mouth extending across the line in a slightly curved line. In its center this fold is greatly widened (see Fig. 6), having a slight central depression or pit with a small one on each side of it. From this widened part of fold a straight sided, naked patch extends backwards having, a trifle below its center, a laneolate pit. Below on each side this naked space throws out an arm terminating in a rounded lobe. Lower down, and separated by a line of hair, are two warts, one on each side of central line, each with a slight depression in its center. The sketch will, I think, explain this more easily than words. The white hair bordering this inverted T-shaped, naked space is very short and fine, quite invisible to the naked eye when the specimen is wet. I have purposely greatly exaggerated its length in the sketch that it may not be overlooked.

Ears divided into two lobes of equal proportion, and form with those of *senex* as figured by Dobson in Catl. Chir. Brit. Mus. Facial cutaneous folds, and the peculiar markings between the fourth and fifth fingers, and internal to the fifth, are apparently the same. These markings are not exactly the same on each side, several of the lines being branched, tuning-fork shaped, and not conforming one side with the other. They, therefore, can probably be but little relied upon for diagnostic purposes.

Teeth $\frac{2-2}{2-2}\ \frac{1-1}{1-1}\ \frac{2-2}{2-5}\ \frac{2-2}{2-2} = 28.$

The only noticeable difference between the teeth of this specimen and those of *senex* (*vide* Dobson) is that in *minor* the second lower

molar is equal to the first instead of the half its size, and sectionally is quadrangular instead of triangular.

Comparative measurements of *minor* and *senex* in millimeters, those of latter species reduced from measurements in inches given by Dobson:

	C. minor.	*C. senex.*
Length of head and body . . . . (about)	65	77
Length of head	20	25
Length of ear	13	17
Length[1] of tragus	4	7.5
Length of forearm	*40.5	53
Length of thumb	13	13
Length of second finger, metacarpal	33	
Length of third finger:		
Metacarpal	37	38.5
First phalanx	14	17.5
Second phalanx	22	23
Third phalanx[2]	11	15.5
Length of fourth finger:		
Metacarpal	34	34
First phalanx	14.5	14
Second phalanx	13	14
Length of fifth finger:		
Metacarpal	36	35.5
First phalanx	14	15
Second phalanx	12.5	14
Interspace between tips of third and fourth fingers	32	
Interspace between tips of fourth and fifth fingers	45	
Interspace between tip of fifth finger and foot . .	52	
Extent of outstretched wings	277	
Length of tibia	17	17
Length of calcaneum	5.5	6.5
Length of foot	14	10

In three of these measurements,—*i.e.*, thumb, fourth metacarpal, and tibia,—the two species measure the same; in three others,—*i.e.*, first phalanx of fourth finger, fifth metacarpal, and foot, *minor* is the larger; in all the other thirteen comparative measurements it is the smaller. The difference in length of forearm, 12.5 mm., is much more than I

[1] This is greatest possible measurement,—*i. e.*, taken on extreme outer margin; that of inner margin is 2.5.

[2] This is the osseous phalanx; with cartilaginous tip it is 14.

have yet found in individual varieties of bats. That of the foot and of the ear, each 4 mm., is great for so short organs. The difference in tragus, 3.5 mm., particularly strikes the attention. I am inclined to believe that this is the least variable organ in bats.

Notwithstanding these differences the closeness of these two bats is very marked, and I should not be surprised if *minor* should eventually prove to be but a variety of *senex*. However, until there is positive evidence that such is the case, it is advisable to consider it as a separate species.

The collector failed to note the date of capture, but informs me that he is certain that it was in July or August, and probably in the former month. From this I imagine that the young bat would have been born some time in September. The specimen was taken at night while flying about a bonfire.—HENRY L. WARD, *Tacubaya, D. F., Mexico, April 20th, 1891.*

EMBRYOLOGY.[1]

Some Notes on the Breeding Habits and Embryology of Frogs.—The following notes are the outcome of several years of observations on the breeding habits and stages in the development of frogs. They are confessedly very incomplete, having been collected rather as an amusement than with any desire to increase our present knowledge of amphibian embryology. Some older observations have been verified, and I believe a few new observations made which perhaps are worth recording. From many points of view I think the development of the frog is better adapted to the need of students beginning the study of embryology than the classical chick. Certainly this seems to be true if a clearer knowledge of the phenomena of development in general is desired, and not merely an introduction to human embryology,—the best excuse offered for presenting the hen's egg and chick, with its mystifying yolk and white and its incomprehensible (to the beginner) larval membranes. On the other hand, the ease with which the young chicks are to be obtained at all seasons makes a very strong argument in their favor. Correspondingly, the difficulties of removing the younger stages of the frog's egg from the surrounding jelly has been a great drawback to its study. Appreciating this last difficulty, I have experimented for several years on methods of removing these

[1] Edited by Dr. T. H. Morgan, Johns Hopkins University, Baltimore, Md.

jelly membranes. At last I think that I have successfully solved the problem, and can now obtain with the greatest ease the most difficult stages, which are also in perfect histological condition. The method will be given in the last section—9. Clay models of the early stages of segmentation of the egg have been a very useful addition in presenting to others the arrangement of the cells. These, of course, should be copied from actual eggs, and not from the perfectly regular (but entirely schematic) figures of the ordinary text-books.

The following topics are touched upon: (1) Time of Laying, and Localities. (2) Laying in Confinement. (3) Polar Bodies. (4) Segmentation of the Eggs. (5) Orientation of the Egg. (6) Enclosure of the Light Pole by the Dark Pole. (7) Effect of Temperature. (8) Times of Hatching, etc. (9) Methods of Technique.

1. *Time of Laying, and Localities.*—The observations were made in the vicinity of Baltimore, Md., during the spring months of the years '88, '89, '90, '91. I shall only speak of those species of whose identity I am certain. Other and more imperfect observations are left out. The first frogs to lay, and amongst the very first (*Acris gryllus* excepted) to appear, are the wood frogs (*Rana sylvatica*). A few warm days in early spring suffice to bring them out. The following records give a general idea as to the time: February 23d, '91, and March 8th, 9th, and 10th, '80. The eggs of these had been laid several days. The egg-bunches are found in small pools on the edges of woods, generally amongst the low hills, and are often stuck to twigs of bushes. The bunches are generally large, four to six inches in diameter, and contain very many good-sized eggs. In the same pools it is quite usual to find the firmer egg-bunches of Amblystoma, as this Urodele also lays its eggs very early.

Somewhat later two species of tree frogs appear in the small pools in the woods, generally in quite small, and therefore, during the day-time, often quite warm, puddles; sometimes in the same pools as the wood frogs, oftener in the ditches by the side of the road. These tree frogs are *Hyla pickeringii* and *Chorophilus triseriatus*. They are often found paired, and may be in this condition carried to the laboratory, where they continue to lay for hours without abatement. The eggs of these species are very similar, and I know no certain method of distinguishing the one from the other. The bunches are small, attached to bits of grass, or lie simply on the bottom, and each bunch contains from five or six to fifteen or twenty eggs. I have the following records of times at which the eggs were found: Hyla—March 9th, 10th, 13th, April 5th, '90; Chorophilus—February 23d, '91, March 13th and 24th, '90.

The eggs of *Rana halecina* are found still later, sometimes in the same localities as the wood frogs, oftener in pools in the open ground quite away from the woods. The eggs are individually smaller, so that although the jelly masses are often as large as those of the wood frogs, the number of eggs is greater. The following are the records: March 25th, April 5th, '90. The eggs of *Rana clamitans* are not so certainly referred to its adult, and I have only strong probability showing them to belong to that species. The bunches much resemble those of *R. halecina*, but the eggs are larger and the jelly firmer. Those I have found were also attached to twigs of bushes, which is not always the case in *R. halecina*.

The toad (*Bufo lentiginosus*) in this latitude lays very late in the spring. The eggs are easily distinguished from the frog's, as they are laid in long strings, often yards in length, the eggs arranged (generally) in a single row. They were recorded April 14th, '90, April 5th and 6th, '91. The best localities seem to be those parts of rivers or streams where the water backs up, and to one side protected by a bar, so that the eggs are not carried away by the water, and where the water itself is often exceedingly warm. Copulating individuals are easily obtained, and they continue to lay in confinement.

2. *Laying in Confinement.*—If frogs are caught at the height of the breeding season, they can often be got to lay in confinement. The surest way is to get the paired individuals, frightening them as little as possible, and placing them in dishes or aquaria containing the requisite amount of water. Only once have I had the wood frogs lay in the laboratory, although with proper precaution there seem to be on very great difficulties of obtaining in this way the eggs of this species. A single large bunch of eggs were laid by this pair during the night, which developed normally.

By far the best and easiest eggs to be obtained by bringing frogs into the laboratory are those of the tree frogs named above. They will continue to lay small bunches of eggs for as much as twenty-four hours after catching them. By removing the bunches as fast as laid, an exact record may be kept as to the age of the different lots. Moreover, the eggs of these species are small and the jelly clear, so that they are well adapted for study of the segmentation stages under the microscope. The distinction between the cells derived from the black (animal) pole and those from the yellow (vegetative) pole is very sharp, and the fate of the cells more easily traced through the later stages of segmentation. Toads brought into the laboratory and placed under proper conditions continue to lay for many hours. A single

copulating pair, which were laying eggs when captured, were isolated *over night* from other individuals, and in the morning a long string of eggs were found. Dr. E. A. Andrews carefully estimated the number of these, and found that inside of ten hours the female had laid the astonishing number of 28,000 eggs, and the male had fertilized them. This was at the rate of forty-one eggs per minute for ten hours. After the eggs are laid the male and female separate, and while formerly they remained quietly in the dishes or aquaria, they now proceed to climb out, and show a tendency to wander over the building.

3. *Polar Bodies.*—I have seen these extruded in the egg of the tree frog. They are found at or near the apex of the black pole, and appear as two white spots with a black periphery. Sometimes they are quite near to each other. Again, I have seen them separated by quite a wide distance. They were extruded about one hour after the eggs were laid as nearly as could be calculated.

4. *Segmentation of the Eggs.*—The series of diagrams ordinarily found in text-books on embryology are exceedingly diagrammatic, and give an entirely erroneous impression as to the appearance of the segmenting egg, especially during the later stages. I found this to be the case in the eggs of the tree frogs (see above) and the common toad, and expected to find a parallel case in *Rana temporaria*,—that studied by Ecker, and from whom the text-book figures are taken. During the present spring ('91) I have procured the early stages of segmentation of this frog, and found it to agree in every particular with other species, and therefore to depart from the text-book or classical type. Rauber has given excellent figures of the later stages of the frog eggs, and in many points I have verified his account. The first furrow divides the egg into two equal halves. The second at right angles to this gives four equal segments. The third furrow is not equatorial, but lies nearest the dark pole of the egg, the result being in four equal black cells and four larger, but equal, light cells. At the next stage the marked regularity of the preceding stages is lost, and each of the eight cells divides, as it were, independently of the rest. The text-book figure at this sixteen-celled stage may be taken to represent an ideal to which the egg never attains. The division of the sixteen cells into thirty-two does not conform to any rule, although again, but in a less degree, Ecker's figures may be taken to represent in the most diagrammatic way possible the planes of cleavage. Without figures it is impossible to describe the precise method of segmentation; those of Rauber approximate, I believe, most nearly to the truth. In general, we may

say that up to the eight-celled stage the segmentation is very regular, but that after that no particular plane of division can be prophesied for any segment. Often during the sixteen-celled stage the upper eight (black) cells are arranged in almost a perfect bilateral symmetry, and not a radial one, as given by Ecker.

5. *Orientation of the Egg.*—The relation of the first plane of segmentation to the adult has attracted a great deal of interest during recent years. The relation found in the frog's egg has been already studied, with varying results. Newport's experiments in 1851, '53, '54, are, I think, the most to be relied upon, and during the present spring I have had the pleasure of verifying his results on a small scale. The eggs of the tree frog were used in the experiment. The outer layers of the jelly were removed from an egg which had not yet divided or had only undergone the first cleavage. A small, triangular piece of card-board was then cut out, and a drop of collodion placed on it. The egg with its thin layer of surrounding jelly was placed on the drop of collodion as soon as the latter began to stiffen, and card-board and egg were then immersed in a dish of water. With a pencil a line was drawn on the card-board corresponding to the plane of first division. The water was changed several times until all trace of ether was gone, and afterward set aside in a quiet and warm place. Several other eggs were prepared by the same process. At the end of forty-eight hours the medullary folds began to appear, and it was then seen that the plane between these corresponded exactly, in most cases, to the plane indicated on the card-board, and therefore the obvious conclusion is drawn that the first plane of division divides the egg into two parts, corresponding to the right and left halves of the adult body. In a few eggs the first plane was somewhat to the right or left of the mid-line of the adult. The embryo begins to rotate in the egg-capsule very soon after the appearance of the medullary folds, so that unless observations are made at the very first appearance of the folds the results will be falsified, on account of the rotation of the embryo from its original position. The eggs of the tree frogs are especially good for experiments such as these, on account of the rapidity with which they develop, decreasing therefore the possibilities of a secondary change in position of the egg after it has come to rest and it plane of division marked. I think it would be possible, by keeping the eggs in a warm room, to cause them to develop the medullary folds within twenty-four hours after the eggs are laid.

6. *Enclosure of the Light Pole by the Dark Pole.*—In studying a series of eggs from the segmentation period to the formation

of the blastopore, the so-called overgrowth or epibolic growth of the black cells has been observed. I am quite sure, however (except in the immediate region on the dorsal side of the blastopore, and later over its whole extent), that the yellow cells disappear from the surface not by an overgrowth of the first-formed black cells, *but by a process of splitting off of cells from the upper corner of the yellow cells themselves.* In other words, there is not a general migration of black cells, but each remains approximately in the position in which it was first formed, and new black cells are continually added at the periphery of the black cap by the splitting off of cells from the upper ends of the yellow cells, so that Balfour's sentence, that the disappearance of the yellow cells "is effected by the epiblast growing over the yolk at all points of its circumference," is somewhat misleading. As a corollary to what I have said, it follows, of course, that there is a continuous formation of new pigment taking place at the periphery of the black area *within the new cells that are being formed, and also within the ends of the yellow cells which go to form the new cells in this region.* I have not studied with sufficient care the gradual turning in of the cells around the rim of the blastopore. In one living egg, however, I saw in the dorsal region of the blastopore some of the cells forming the floor of the archenteron gradually disappear *within* the blastopore.

7. *Effect of Temperature.*—It is impossible to give any exact time to the different stages of development, as the time is directly proportional to the temperature of the water within certain limits. The highest temperature is not always the optimum, for several bunches placed in an incubator for hen's eggs were entirely destroyed. The freezing of the water in which the eggs are kept does not seem to injure the eggs in the least, but simply to retard their development. I have had eggs completely surrounded by ice, and afterward development quite normally. However, when the eggs themselves are actually frozen they seem to be destroyed, perhaps by the formation of ice spicules within them. The wood frogs, which lay their eggs so early, generally lose in this locality great numbers of them on account of getting caught in the ice. Those which are not so caught develop later, when the ice melts, and do not seem, in any way, to be injured by water at the freezing-point. I think there is here a most interesting field for experimentation by the physiological embryologist, and I regret I have not kept exact records of the effects of heat and cold.

8. *Times of Hatching, etc.*—The different species of frogs leave the jelly membrane at different ages. Some have the tail well developed, and are quite active. Others have the tail just appearing, and are

only able to twist their bodies slowly from side to side, as they cling to the jelly-mass by means of the suckers below the mouth.

The young tadpoles of the wood frog leave the water as small frogs in the late spring of the same year in which they were laid,—that is, become frogs in four to six months. Eggs collected about March 17th began to change to frogs about June 1st to 14th. These were kept in quite cool water, in a basement room, away from the sunlight.

At the time of transformation into tadpoles *a sudden decrease in the length of the intestine is brought about.* The tadpoles cease to eat, and the intestine is entirely freed from extraneous matter during this time. The change takes place at the same time that the tail is absorbed within the body (not dropped off, as popularly supposed), and at the same time the pair of fore feet, which were enclosed within the branchial fold, break through to the exterior. The intestines were removed and measured from the pyloric end of the stomach to the proximal end of the rectum. Their lengths are recorded in the accompanying table for the wood frog:

(*a*) From a large tadpole, with whole tail and two large posterior feet. (*b*) From a tadpole, with whole tail and two large posterior feet. (*c*) From a tadpole, with whole tail and two large posterior feet. (*d*) From a young frog, tail beginning to disappear, and four feet. (*e*) From a young frog, $\frac{1}{5}$ tail and four feet. (*f*) From a young frog, ½ tail and four feet. (*g*) From a young frog, no tail, and out of water two weeks.

9. *Methods of Technique.*—The eggs during the periods, in which it is difficult or impossible to remove the inner jelly membrane, can

be freed in the following manner: With a pair of sharp scissors each egg must be cut out from the general jelly-mass, retaining as small an amount of surrounding jelly as possible. It is then put into an alcoholic solution of picric acid for an hour or longer (one to twelve). The solution is prepared by saturating 35 per cent. alcohol with picric acid, and adding the same amount of sulphuric as in Kleinenberg's solution. The solution is not diluted, but used saturated with picric acid. The eggs are then washed for several hours in 35 per cent. alcohol, several hours in 50 per cent. alcohol, and placed in 70 per cent. for several days, changing the alcohol once or twice if necessary. About the second day the inner membrane begins to swell, due to a slow osmotic action, I think, as the membrane is stretched by tension from within. On the third or fourth day the swollen membrane may be pierced by a sharp needle, and the egg taken out, which is then placed permanently in 80 per cent. alcohol. The method is exceedingly simple, and consists largely in waiting a few days for the osmotic action to take place. Such eggs, if properly prepared, are in excellent histological condition. This simple method has proved so successful that I have not further experimented with it. It is possible that it may be improved by varying the strength of alcohol used, but I have not seen the need of looking further. The membrane does not swell in stronger alcohol than 70 per cent., and weaker would macerate the eggs.

Certain precautions are necessary in imbedding the eggs to prevent brittleness. This is obviated by soaking the eggs before imbedding, for several hours, in a solution of turpentine saturated with paraffine, and kept in a warm place,—not so hot as the water-bath (50° C.). Heat causes the egg to become brittle. This is obviated by the above process of soaking, so that the egg need not remain so long as an hour in the melted paraffine of the water-bath. In the younger stages there is no need for very thin sections, but sections 10 μ thick are sufficent for all purposes. If the sections are cut too thin the yolk tends to break up and crumble.—T. H. MORGAN, *May 1st, 1891.*

ENTOMOLOGY.[1]

The White Wax Insect.—The following account of the production and use of the white wax of China, about which very little is known in America will be read with interest. We find it in the issue of the N. C. and S. C. and C. *Gazette* for March 26th, 1891.

The native candles of the north are made of sheep's tallow, but those of the central provinces are partly manufactured from bean oil, which is able to be utilized for this purpose by the addition of white insect wax in the proportion of about one-eighth. Where bean oil cannot easily be procured the seeds of *Stillingia sebifera* are employed. This tree grows most extensively in the south. A picul of its seeds yields twenty or thirty catties of tallow, and when this has been pressed out, subsequent grinding and steaming result in the production of an oil called *ch'ing yu* out of the albumen. Insect-made white wax is added in the proportion of three catties to a hundred catties of the tallow. It is the wax which gives it sufficient consistency to remain thoroughly congealed in ordinary temperatures. From Hankow in 1889 about 120,000 piculs of the tallow of the tallow tree were exported, and of this quantity nearly half found its way to Shanghai in the same year. An enormous quantity of candles are made in Shanghai and its vicinity, and the pressing out of bean oil for the manufacture employs a large number of water buffaloes. The old industry is that which has for many ages made use of the tallow-tree product. The new has grown out of the Newchwang trade which supplies Shanghai with beans. The vast industry which is an essential to the use of the vegetable tallow began, we are told, about six centuries ago. Till recently we knew generally that the wax is made at Luchou Fu, in Anhui, at Kiahing in Chêkiang, at Hinghua Fu in Fukien, as well as in Hunan, in Kweichou, in Yunnan and Szechuan. But the processes were never fully described, and there was a need for fuller information. That want has been supplied by the inquiries of Mr. Alexander Hosie, of the British consular service in Szechuan. The tree on which the insects produce the wax is an inhabitant of a different part of the country from that which produces the insects. Chinese ingenuity brings the insects from their birthplace to their new home many miles away, and sets them to the work of wax-making. It is this curious history which Mr. Hosie has been the first thoroughly to investigate.

[1] Edited by Prof. C. M. Weed, Hanover, N. H.

The white wax insect was frequently referred to in old works on China. One object of Mr. Hosie's recent journey to the Chienchang valley near Mount Omi was to procure from the tree on which the insect live specimens of the foliage and flowers, for Sir Joseph Hooker. These he procured, and specimens of the living tree with the incrusted white wax on it, as well as samples of the latter, as it appears in commerce, and of the Chinese candles made from it. The said valley is 5,000 feet above the level of the sea, and is the great breeding ground of the insect. The tree is an evergreen, with the leaves springing in pairs from the branches, very thick, dark green, glossy, ovate, and pointed. In May and June it bears clusters of white flowers, succeeded by fruit of a dark purple color. The Kew authorities now say it is the *Ligustrum lucidum*, or large-leaved privet. In March Mr. Hosie saw on the trees certain brown pea-shaped excrescences attached to the bark of the boughs and twigs. Opening some larger ones they presented either a whitey brown pulpy mass, or a crowd of minute insects looking like flour. Their movements were just perceptible to the naked eye. From two or three months later they become brown creatures, with six legs and a pair of antennæ. These are the white-wax insect or *Coccus pela*. There is a beetle which is a parasite on the Coccus. It is a species of Brachytarsus. It is found in many of the excrescences above mentioned, and burrows in the inner lining of the scale, which seems to be its food. When a scale is plucked from the tree the Cocci escape by the hole which is made. It is in the town of Kiating that insect white wax is produced. This city is 200 miles to the northeast of the Chienchang valley. The scales are gathered in the valley, and made up into paper packets of about sixteen ounces each. Sixty of such packets make a load, and they are conveyed by porters from the valley to Kiating in the night-time. If carried by day the insects would develop and escape from the scales. As it is, an ounce is lost in transit. A pound of scales in good years is sold for half a crown. In bad years it is worth twice this amount. In favorable years a pound of scales produces four or five pounds of wax. In the plain around Kiating very many plots of ground are seen edged with stumps, from three or four to twelve feet high, with numerous sprouts growing from their gnarled heads, as on pollard willows in our own country. The tree is probably *Fraxinus chinensis*,—a kind of ash. The leaves spring in pairs from the branches, and are light green, ovate, pointed, serrated, and deciduous. On the arrival of the scales in May they are made up in small packets of from twenty to thirty scales, which are enclosed in a leaf of the wood oil tree. Rice straw

is used to suspend the packet under the branches of the ash or white-wax tree. Rough holes are drilled in the leaf with a blunt needle, so that the insects may find their way to the branches through the openings. The insects creep rapidly up to the leaves, where they nestle for thirteen days. They then descend to the branches and twigs, and take up a position on them. The females then begin to develop scales on which to deposit their eggs, and the males to excrete the substance known as white wax. It first appears as an undercoating on the side of the boughs and twigs, looking like snow. It spreads gradually, till in three months it is a quarter of an inch thick. In a hundred days the deposit is complete, and the branches are lopped off. The wax is removed chiefly by hand, and is placed in an iron pot of boiling water. The wax, on rising to the surface, is skimmed off, and deposited in a round mould. This is the white wax of commerce. It is used to coat the exterior of animal and vegetable tallow candles, and to give greater consistency to the tallow. It is also used to size paper and cotton goods, to impart a gloss to silk, and as a furniture polish. From Hankow each year at present about 15,000 piculs of white insect wax are exported in a year, and the main portion of it finds its way to that port from Szechuan. Chinkiang absorbs 1,000 piculs, and Shanghai 14,000 piculs. At Shanghai one-half is for home use, and the other half to distribute again to other ports. Tientsin requires 1,000 piculs, and Canton and Swatow a thousand piculs each. Thus it appears that while Szechuan is not the only producing center of insect white wax, it produces enough to furnish the most distant cities with the means to make a sufficient number of candles to maintain the temple worship, as well as to enable the people everywhere to equip their lanterns for walking in the evening, and aid in night illumination generally.

Recent Station Bulletins.—Mr. James Fletcher, of the Central Experimental Farm of Canada, has recently issued an admirable popular bulletin (No. 11) concerning injurious insects and insecticides. The Delaware Station issues as Bulletin No. XII. a somewhat similar account of certain noxious species, together with a record of experiments with remedies. Prof. C. P. Gillette issues as Bulletin No. 15 of the Colorado Station timely articles concerning the Codling Moth and Grapevine Leaf-Hopper. Mr. H. E. Weed, of the Mississippi Station, publishes as Bulletin No. 4 a pamphlet of forty pages, in which he discusses the following topics: The Screw Worm, Pea Weevil, Bean Weevil, Striped Cucumber Beetle, Ox Warble Fly, Plum Curculio, Codling Moth, Insecticides, and Spraying Machinery.

Food Habits of Coccinella convergens.—Since the publication of Prof. Forbes's paper upon "The Food Relations of the Carabidæ and Coccinellidæ" various obververs have found that at least one species (*Megilla maculata*) of the family Coccinellidæ is a vegetable feeder.

I have noticed another species, *Coccinella convergens*, doing considerable damage to cabbage plants this season. The first noticed cabbage thus eaten was sprayed with Paris green, and upon examination the day following several dead specimens of *C. convergens* were found on the ground under the plant. Since then I have noticed others eating the leaves of several cabbage plants.—*Howard Evarts Weed, Mississippi Agricultural College.*

Transformations of Coleoptera.—Mr. Wm. Beutenmüller, of the American Museum of Natural History, has lately published in the Journal of the New York Microscopical Society (Vol. VII., pp. 1–52), a Bibliographical Catalogue of the Described Transformations of North American Coleoptera, for which he deserves the thanks of his entomological brethren. In arrangement and style it is similar to Mr. Henry Edward's catalogue of Lepidoptera. Three hundred and ninety-six species are included in the list,—a striking commentary upon the paucity of our knowledge of the immature stages of this great order.

ARCHEOLOGY AND ETHNOLOGY.[1]

The International Congress of Anthropology and Prehistoric Archeology of Paris, 1889.—(*Continued from page 679*).

Sixth Question: "Firstly, The Human Remains of the Quaternary Epoch Discovered Within the last Fifteen Years; and secondly, The Proper Ethnic Elements Belonging to the Men of the Different Ages of Stone, Bronze, and Iron."

The discussion of this question was opened by Monsieur Fraipont, of the University of Leige, Belgium, who had been the discoverer of the celebrated cavern of Spy, on the river Meuse, in Southern Belgium. He exhibited the skulls and bones which he had there found, and said that these were the most complete representatives now known of the race of Canstadt, as has been classified by MM. de Quatrefages and Hamy. This man was contemporaneous with the mammoth

[1] Edited by Dr. Thomas Wilson, Smithsonian Institution, Washington, D. C.

and the *Rhinoceros tichorinus*, but was subsequent to and not contemporaneous with the *Rhinoceros merkii* and the *Elephas antiquus*. Monsieur Fraipont enumerated the pithecoid characters found in the skeletons of Spy, and concluded that there was "an ascending evolution, the most characteristic of humanity" during the Quaternary Period.

Monsieur de Quatrefages reserved his opinion upon the characters named by Monsieur Fraipont as simian or pithecoid.

Dr. Topinard was doubtful if the facial portion of the skull of the man of Spy was correct, and in consequence thereof the osteology of the face must rest doubtful.

Monsieur Manouvrier admitted the general resemblance of the men of Spy with those grouped around the skull of Neanderthal, but explained some of their diversities. He investigated the morphology of the femur and tibia of the men of Spy, and interpreted it differently from Mr. Fraipont.

Dr. Deniker could not agree with M. Fraipont in the simian characters which he found in the man of Spy. Dr. Topinard stated also, on the side of Dr. Deniker, that the incurvation of the tibia existing among the gorillas is not found among the orangs.

M. Fraipont explained his meaning of the terms simian and pithecoid, so that they did not appear so strong as he had at first stated.

Dr. Hamy said that the discovery made by M. Fraipont at the cavern of Spy gave proof of the existence near the middle of the Quaternary period of the existence of a special human race. His discoveries had rehabilitated the skull of Neanderthal, and completed the passage between the exaggerated type of that race and the specimens less accentuated of Brux of Canstadt and of Engisheim, and permits us to utilize the most precious pieces known, now nearly forgotten, the debris of the skeleton of Lahr. Dr. Hamy recounted the circumstances in which Ami Boue discovered the skeleton of Lahr in 1823, of their translation to the museum, and that they had finished by taking their legitimate place by the side of the remains from Neanderthal and de la Naulette. He described rapidly the bones of each member, the fragments, etc., going on from head to foot, and showed the analogies which these pieces presented with those of Spy, and demonstrated by these comparisons that the skeleton of Lahr was indeed contemporaneous with the Lehm from which it had been extracted, and it was now, by reason of the discovery of Spy, to be classed among the human remains of the race of Canstadt.

Dr. Hamy, continuing the discussion of Question Sixth of the program, reviewed the new documents on the subject of the archeology of the primitive human race since the publication of his great work on the Crania Ethnica. The fragments found in the Grotte de Gourdan, which had been recently published, the under jaw from the Grotte of Malarnaud, found by M. Regnault, and described by M. Filhol, and which M. Hamy had presented,—these are, along with the bones of the men of Spy, the only new acquisitions of the race of Constadt.

The race of Cro-Magnon is represented by several new discoveries, of which the most important was the discovery of the skull in the Grotte du Placard, which had been exhumed by M. Maret.

Dr. Hamy described this piece, and assigned it a place in the anatomic series of the race of Cro-Magnon. We possess, said he, no new document or specimen of the types of Furfooz, the second type of which appears more and more to attach itself to the age of polished stone, which furnishes from one time to another in Southern Belgium new specimens, more or less characterized as belonging to this ethnic group.

Monsieur Felix Regnault sent a human lower jaw, incomplete, found in the Grotte of Malarnaud, in Ariege. Dr. Hamy declared it to have great affinity with the similar pieces from Naulette, Goyet, etc., and other caverns in Belgium.

Monsieur Marcellin Boule described the caverns of Malarnaud from which this under jaw came, and presented to the congress his written notes thereon. A section of the earth of the cavern and the place where this jaw was found was thus composed: 1st, the superficial rubbish; 2d, the deposit of clay and gravel containing the remains of divers animals of prehistoric times,—the auroch, the reindeer, the mountain goat, etc; 3d, a strata of stalagmite; 4th, clay and gravel, —in this were the cave bear and lion, the wolf, mammoth, etc., and it was from this strata that the under jaw came. This is the stratum of the machoire de la Naulette, the skeletons of Spy, the skull of Engisheim, and probably that of Neanderthal. There were no specimens of *Elephas antiquus*, *Rhinoceros merkii*, or hippopotamus, or the animals characteristic of the early Quaternary period, and which correspond to the human industry of Saint-Acheul and Chelles, and therefore, said Monsieur Boule, the Quaternary prehistoric man,—he of the Chelleen epoch,—remained still unknown.

Dr. Lagneau gave it as his opinion that this under jaw of Malarnaud belonged to the race of Canstadt or of Neanderthal, and he spoke of

the great extension of territory which this man covered in prehistoric times.

M. de Quatrefages presented a manuscript of M. Hardy, of Perigueux, which was entitled, "The Discovery of a Sepulchre of the Quaternary Period of Chancelade in Dordogne," and gave several observations upon the skull of which Hardy has presented the photograph. The skull was dolichocephalic, but asymetric; the face large, the orbits of elongated form; the front was well developed, the femurs were columnar, the tibias platycnemic, and it altogether presented the most striking and apparent characteristic of the race of Cro-Magnon.

M. Manouvrier read a communication on the platymetry or flattening of the antero-posterieur of the upper third of the diaphyse of the femur, that he had often observed upon human femurs in the neolithic period.

M. Goldstein presented his pantometre, and explained its use and necessity in anthropological photographs.

Dr. Verrier presented two Australian skulls.

Dr. Soren Hansen presented his paper on prehistoric trepanning.

Dr. Benedickt explained his method and apparatus on crainometry, and referred to his display at the exposition.

Dr. Jacques presented the human remains gathered by the brothers Siret in Spain. These brothers Siret were civil engineers in Antwerp, and I had the privilege and the pleasure of visiting and studying their collection while in that city. Their excavations were conducted principally in Southeastern Spain, in the country between Carthagene and Almeria. We have their magnificent and extensive volume, costing $100, in our library. Their investigations were regular, methodical, and scientific. The prehistoric epoch to which these investigations belonged were principally the neolithic period and the age of bronze.

Dr. Jacques had studied seventy of these skulls and skeletons, the former complete, the latter more or less so, and gave his opinion as to the divisions to be made as to the races to which they belonged. One race, the most common, presented many analogies with that of Cro-Magnon, but with an occasional characteristic of the type of Furfooz. The race of Furfooz was there shown by some specimens, though not so frequent as the former. A third group identified by Dr. Jacques compared with those of the Basques, and his conclusion was that the neolithic people southeast of Spain comprised individuals belonging to the most ancient epoch in the Iberian peninsula.

Dr. Topinard delivered a most interesting address, entitled "Paleo-

anthropology." He said the congress was interested in prehistoric anthropology as in prehistoric archeology. There was a paleo-anthropology as a paleoethnography. The former required the services of a naturalist and anatomist; the latter required the ethnographer and the archeologist. The excavator serves to unite the two former, as the traveler serves to unite the two latter. It is because of, or by means of, this link that the work of the one is rendered beneficial to and aids the other. It is exceedingly rare that the anatomist is an explorer. For every one competent archeologist there are hundred amateur excavators. The latter interest themselves bu slightly over the human remains. Museums and private collections are gorged with industrial and artistic objects of prehistoric man, but are almost entirely without any of his remains. He lamented these gaps in the means of our information, and was much impressed with our poverty in this regard when he came to make an inventory of our knowledge concerning the ancient races of man. He declared the necessity of having numerous series in order to study with success the craniology, and entered into the details of methods employed in order to find the necessary facts, and gave a rèsumè of our knowledge concerning our prehistoric ancestors. Then followed his remedy. He proposed that the congress should take the initiative in preparing detailed instructions for the usage of excavators, in which, said he, they can be made to understand that the work on which they are engaged is indefinitely more difficult than they had believed, that the skulls and human bones are at least as interesting and as valuable to preserve intact as the objects of human industry. He declared in unmistakable terms that prehistoric stations, once disturbed, were forever destroyed. He enlarged upon the necessity for anthropological science that the excavations, when done, should be well done; if not, they are lost to us, or our children and our grandchildren, and a great part of our national treasure will be scattered and destroyed.

MM. Cartailhac and de Mortillet came to the aid of Dr. Topinard, and seconded him in his views. It was finally agreed that a commission should be appointed which would be charged with preparing these instructions, and the congress appointed Drs. Topinard, Hamy, Reinach, and Cartailhac to prepare it.

(*To be continued.*)

Preliminary Notes on the Archeology of Southwestern New Mexico.—In connection with the geological work which the writer has been conducting in Southwestern New Mexico, during the past two years, investigations in the archeology of the region have also been pursued, and with gratifying results. This ancient home of the

Aztecs and cliff-dwellers is indeed one of the regions o the most profound interest to the archeologist to be found on the American continent. Almost everywhere on the now bare and desert plains, in the fertile valleys, lovely cañons, and even lofty mountain-tops, the ruined houses and pueblos of this most interesting and once-powerful people, exist.

It is evident that both the Aztecs and cliff-dwellers (were they distinct races?) were driven out by a stronger race, whether by the Spaniards or others. Their houses have been burned, and in every room in the ancient pueblos which the writer has examined there are found from one to several well-preserved skeletons of men, women, and babes, all apparently laying where they fell by the hands of foes.

All inflammable material, as the reeds, grasses, and poles forming the roof and posts, have been consumed, and the rocks and adobe fallen in, burying the bodies of their former inhabitants where they fell. Generally the household utensils, etc., are found where they were apparently last used.

In the Mimbres valley and elsewhere these ancient ruins are very numerous, occurring from one-fourth to two miles apart.

In making excavations in these ruins the writer has found beautiful clay and sandstone dishes, clay (made from fragments of painted pottery), bone, stone, and turquoise beads and ornaments, various stone implements, utensils, etc.

At Cook's Peak extensive mining operations were carried on by these ancient people,[1] and now are to be seen large numbers of their ancient workings, which had been filled with débris worked from the mountain-side, but which have since been cleaned out, and the mines now worked.

These old mines are of great interest, and much time and study have been given them by the writer. The ore is mainly a low-grade argentiferous "sand-carbonate." In mining, fire and water and rude stone hammers were used.

Of these hammers the writer has found more than thirty. When these mines were cleaned out ashes and large quantities of charcoal were found, all presenting as fresh an appearance as if the work had been done but a short time ago. When the hard galena ore was reached the mines were abandoned. There have been found in these mines small voyers, broken pottery, arrow-points, bone, crystal, and turquoise beads, stone hammers, etc., most of which are now in the writer's possession. I also found a small, rude smelter near one of these antique mines, and a quantity of slag close by.

[1] It may yet prove that the mines were worked while these people were *peoned* by the Spaniards.

Near these mines ancient reservoirs for the storage of water are found in the "gulches." The water doubtless was used in mining.

In some sheltered places in the valleys and cañons can still be plainly seen old cornrows and *sakeys* (irrigating ditches).

On the east, west, and middle branches of the Gila River, in the Mogollon Mountains, is to be found as rough, wild, and broken a tract as is to be discovered in any part of the great Rocky Mountain region. Here in the rugged cliffs are found great numbers of ancient cliff-dwellings, some of which are unsurpassed in interest.

Considerable time was devoted to the study of these dwellings, making explorations in, and plans and sketches of, them, as well as drawings of many of the more interesting and extensive hieroglyphics painted on the rocks by the former inhabitants of these dwellings. One of these ancient cliff-dweller's pueblos (if I may so term it), situated in a lofty cliff which forms the side of a deep, narrow cañon that extends out from the west branch of the Gila, is of special interest in many ways. This cliff-dwellers' village is in a fine state of preservation, and consists of upwards of twenty-eight rooms.

Several days were spent in making explorations in these dwellings. Large quantities of valuable relics were found in the débris of the rooms. Among the relics obtained were specimens of several kinds of cloth, all made from the fibre of the Spanish dagger, matting of bear-grass, willow-work, sandals, cords of various sizes, feather-work, a ball and large skein of twine of the same material as the cloth, human and animal bones, stone utensils, great quantities of corn-cobs, corn, squash or pumpkin rinds, seeds, and stems, corn-husks, beans, gourds, pottery, braided human hair of a brown color, etc. ; and last, but by no means least, a perfectly preserved cliff-dweller mummy. This was a mummy of a small child, with soft brown hair, similar to that found braided, only finer. It was closely wrapped in a considerable amount of two varieties of coarse cloth, woven from the fiber of the Spanish dagger, then wrapped in a large, nicely woven mat of bear-grass, and tied on by cords of the same material as the cloth to a small, curiously shaped board of cottonwood. The position relative to the relics found, together with much other evidence, demonstrate conclusively that this is a mummy of a true "Cliff-dweller."

So far as I am aware, this is the only specimen of its kind ever discovered; and as to the value of the relic and discovery every archeologist can judge.

In the near future I propose to publish a detailed account of the results of my archeological researches in this strange country.—Clement L. Webster.

MICROSCOPY.[1]

The Nervous System of Convoluta.[2]—The discoverer of the nervous system of the acœlous Turbellaria, Yves Delage, recommends gold chloride as a means of demonstration.

A number of Convoluta are placed in a watch-glass, and most of the sea-water removed. Formic acid (33 per cent.) is then poured over them, killing them almost instantly. At the end of two minutes the formic acid is removed, and gold chloride (one per cent.) put in its place. After ten or twelve minutes' exposure the gold chloride is replaced by formic acid (two per cent.), in which the Convoluta remain, in the dark, until the stain is complete (from one to three days). It is well to allow the planarians to become uniformly violet and opaque, and then to decolor them with cyanide of potassium (one-half per cent.). This reagent is allowed to act, according to the case, from two to twenty-four hours. The decoloring action can be arrested by washing with formic acid (two per cent.). The preparations can be mounted in balsam, but glycerine, with a slight admixture of formic acid, gives the best results. The prolonged action of the formic solution renders the animals supple, so that they are easily arranged on the slide.

The results obtained with gold chloride are notoriously variable. According to Delage's experience, out of three or four trials one at least is sure to be a success. In the same operation the results are different for different individuals. The best-stained specimens are easily recognized with a low magnifying power, and these alone are set aside for mounting.

If sections are required, the worm, after being decolored in formic acid, must be hardened in the usual grades of alcohol. It is important to have the object extended and free as possible from wrinkles and contortions. This end can be best secured by subjecting the worms to slight pressure under a cover-glass while applying the formic acid (33 per cent.). Even then many of them will find space to twist themselves out of shape, but some will remain straight, and these can be selected for cutting.

In order to cut several individuals at once, all oriented alike, Delage passes them through chloroform, with a mixture of chloroform and paraffine. From this he removes them to a slide smeared with oil, and

[1] Edited by C. O. Whitman, Clark University, Worcester, Mass.

[2] Yves Delage. Arch. de Zool. Exp. et Gén, 1886, p. 113.

arranges them with a small brush. The slide is then carefully lowered into a dish of warm paraffine, and usually reaches the bottom without deranging the specimens. After cooling, the slide is taken out with the Convoluta still in place. From six to a dozen may thus be imbedded and cut in a single series.

Osmic Carmine for the Histology of the Nervous System.—The gold chloride method serves only for the coarser anatomical features of the nervous system. The finer structure can be studied to best advantage after treatment with osmic carmine. This new reagent is prepared as follows: Take a strong solution of carmine in ammoniacal water, and evaporate it on a water-bath until the appearance of red clouds on the surface indicates that the excess of ammonia has disappeared. After cooling, add an equal volume of osmic acid (one per cent.), and filter under a bell-jar. A very dark fluid is thus obtained, which has the staining properties of carmine and the fixative properties of osmic acid. At the end of some days this reagent loses its odor and becomes darker. Its fixative properties have disappeared, leaving it a good macerating reagent. It is best, therefore, for preservative purposes to mix the acid and the carmine solution at the time of using, or at least not many days before.

The Convoluta designed for sectioning ought to die extended. They will do this in a concentrated solution of sulphate of iron. As soon as they have been killed by this reagent they should be transferred to the osmic carmine, and left from one-half to twelve or more hours, after which they may be hardened in the usual grades of alcohol

For the examination of the "frontal organ" (olfacto-gustatory organ) in the living animal it was found necessary to resort to some immobilizing agent. Experiments with the various agents in common use showed that chlohydrate of cocaine (ten per cent.) was the best. A drop of a solution in distilled water was placed on a slide and evaporated slowly over a lamp. When the water had disappeared and the slide had cooled a number of Convoluta were placed on the small spot of cocaine by the aid of a pipette, leaving as little water as possible, so that they would be slightly compressed by the cover-glass. A good immersion lens was necessary, and examination had to be made with haste, as only two or three minutes elapsed before the tissue became opaque and began to change.

SCIENTIFIC NEWS.

A living illustration of the truth of the evolution theory has been dredged in 392 fathoms off one of the Galapagos Islands, in the shape of a stalked crinoid, or sea lily, in which are united the characteristics of three distinct fossil genera of the same group of organisms,—Apiocrinus of the Bradford clay deposits, Hyocrinus, and Rhizocrinus This interesting survival of a very old and complex type will shortly be described by Mr. Alexander Agassiz.

Dr. Schliemann, like Robertson "the naturalist of Cumbrae,"—whose life, by the Rev. T. R. R. Stebbing, has just been issued by Messrs. Kegan Paul & Co.,—is another striking illustration of the class of men who become distinguished in science in spite of adverse circumstances in early life and subsequent pressure of business avocations. Mr. Robertson in his youth was a farm laborer, but found opportunities, nevertheless, to cultivate his mind as well as the soil. He passed through a Glasgow medical course, but selected a business career, and retired on a competency thirty years ago. Then he found leisure at last to gratify his tastes for natural history, settled on the island of Cumbrae, and worked at various branches of marine zoology, observing and recording natural phenomena. He is acquainted with many distinguished naturalists, and enjoys an honorable and honored old age.

The ninth annual report of the Geological Survey of the United States, for the years 1887–'88, recently issued, is of unusual general interest, as it contains full accounts of the great earthquakes in Charleston and its vicinity, from persons who witnessed the shocks,—that of Mr. Carl McKinley, editor of the *Charleston News and Courier*, being a most vivid and realistic description,—and from numerous well-equipped scientific observers. The city of Charleston, with the exception of Boston, was the oldest and most English-looking of any in the United States. It is interesting to note, from the report of Dr. C. E. Manigault, that the houses built prior to the revolutionary era on the English system of bricklaying, in which shell lime was used, sustained the successive shocks with the least injury. After 1838 inferior lime and methods of building were adopted, and these erections suffered severely. Not half a dozen houses escaped altogether. Nearly twenty buildings were burnt, and all of these were on fire at once on the first eventful night. The actual number of killed was

seven whites and twenty colored persons; of deaths attributed to cold and exposure, eighty-seven. The number of wounded was never ascertained. Low wooden houses appear to be the best suited and safest habitations in earthquake regions. The shocks were felt as far north as Toronto in Canada, south as the island of Cuba, east as Boston, and nearly a thousand miles off in a southwesterly direction in the upper Mississippi region. The volume is illustrated with views of the ruins of Charleston and Summerville, of the fissures on the banks of the Ashley River near the phosphate works, the craterlets of Summerville, and many plans, maps, and diagrams. In fact, the Charleston earthquake was the best observed and most photographed "shake" on record. The shocks traveled at the rate of three miles per second.—Agnes Crane.

The summer meeting of the American Geological Society is to be held Monday and Tuesday, August 24th and 25th, in the Columbian University, Washington, D. C., and will doubtless be one of unusual interest. The meeting will be preceded August 19th to 22d by the meeting of the American Association for the Advancement of Science, and will be followed by the International Geological Congress, which meets August 26th, and remains in session one week. The three societies will meet in the same building. The foreign members of the International Geological Congress are to be invited to read papers before the Geological Society, and their papers will be given precedence on the program. A number of excursions will probably be arranged. The local arrangements are in the hands of a committee, Mr. G. K. Gilbert, chairman.

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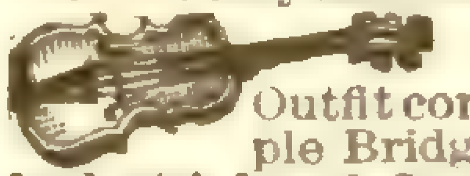

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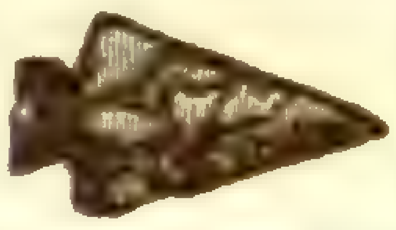

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THE August Number of the *North American Review* will contain articles on the Jewish question, by Prof. Goldwin Smith, in which he attempts to show that the antagonism to Hebrews in Russia is due to social and economic rather than religious causes; on the Value of Naval Menœuvres by J. Russell Soley, Assistant Secretary of the Navy; on the Possibilities of the Steam-Yacht, by Lewis Herroshoff, of the famous firm of yacht builders; on Vampire Literature, by Anthony Comstock, Secretary of the Society for the Suppression of Vice; on the Scientific Basis of Belief, by Prof. R. H. Thurston, of Sibley College, Cornell University; on the State as an Immoral Teacher, by Ouida; on Pensions and Patriotism, by Gen. Green B. Raum, Commissioner of Pensions; on How to Rest, by Dr. Wm. A. Hammond; on the New Political Party, by the Governor of Oregon, and on Trades-unions for Women, by Lady Dilke. The same number will also contain a very remarkable article by Mr. Dana, the editor of the *Sun* describing the extraordinary experiences of a spy who was employed by the War Department during his tenure of office as Assistant Secretary of War.

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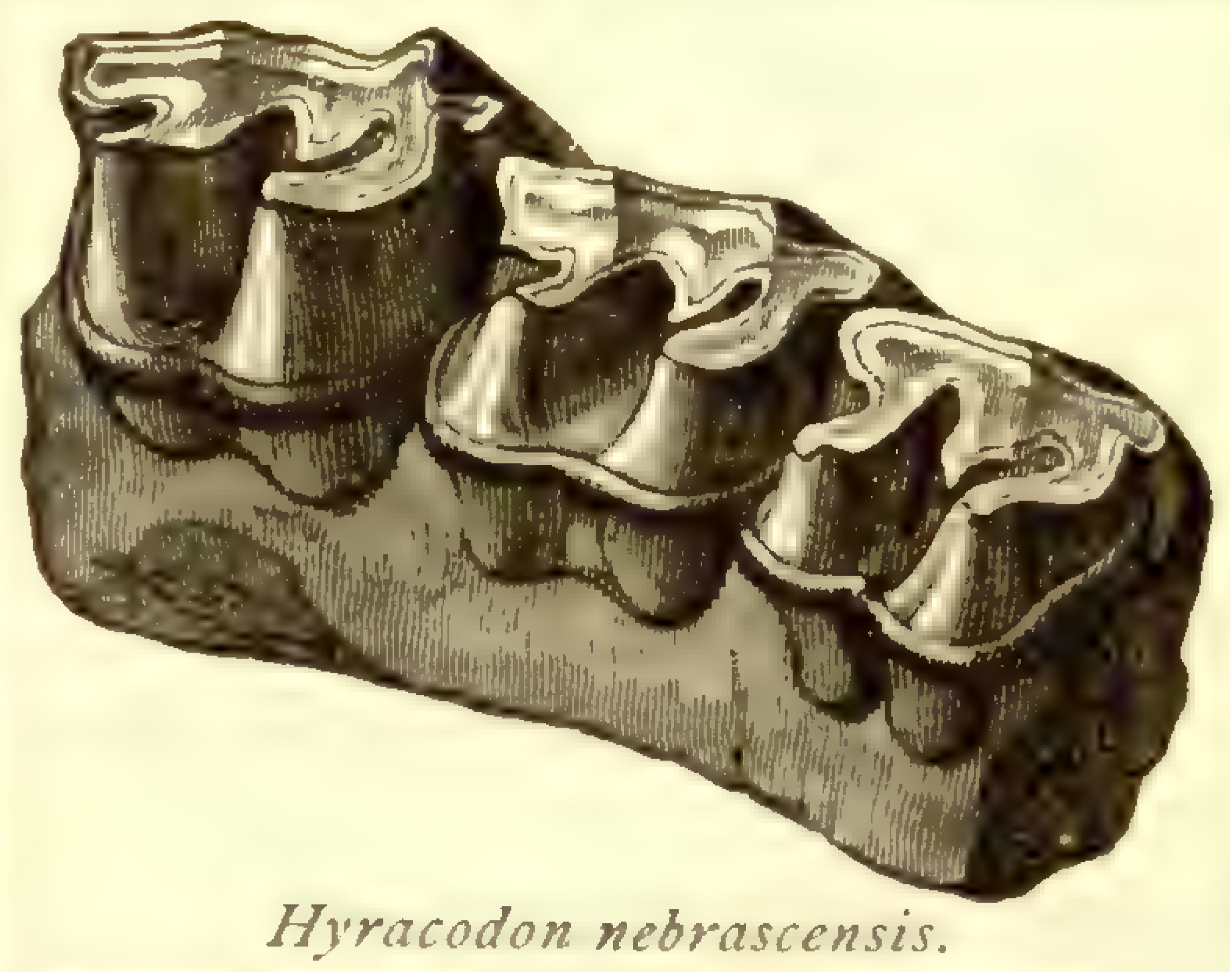

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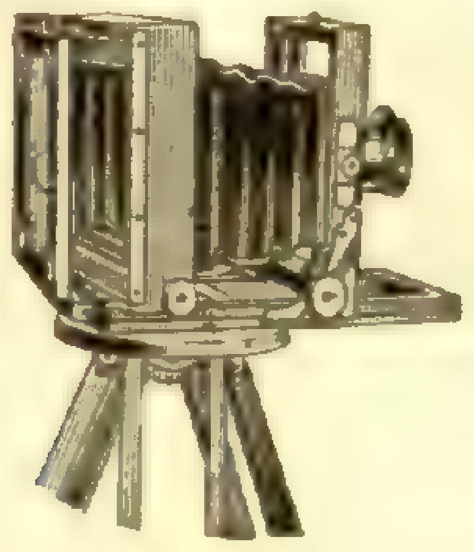

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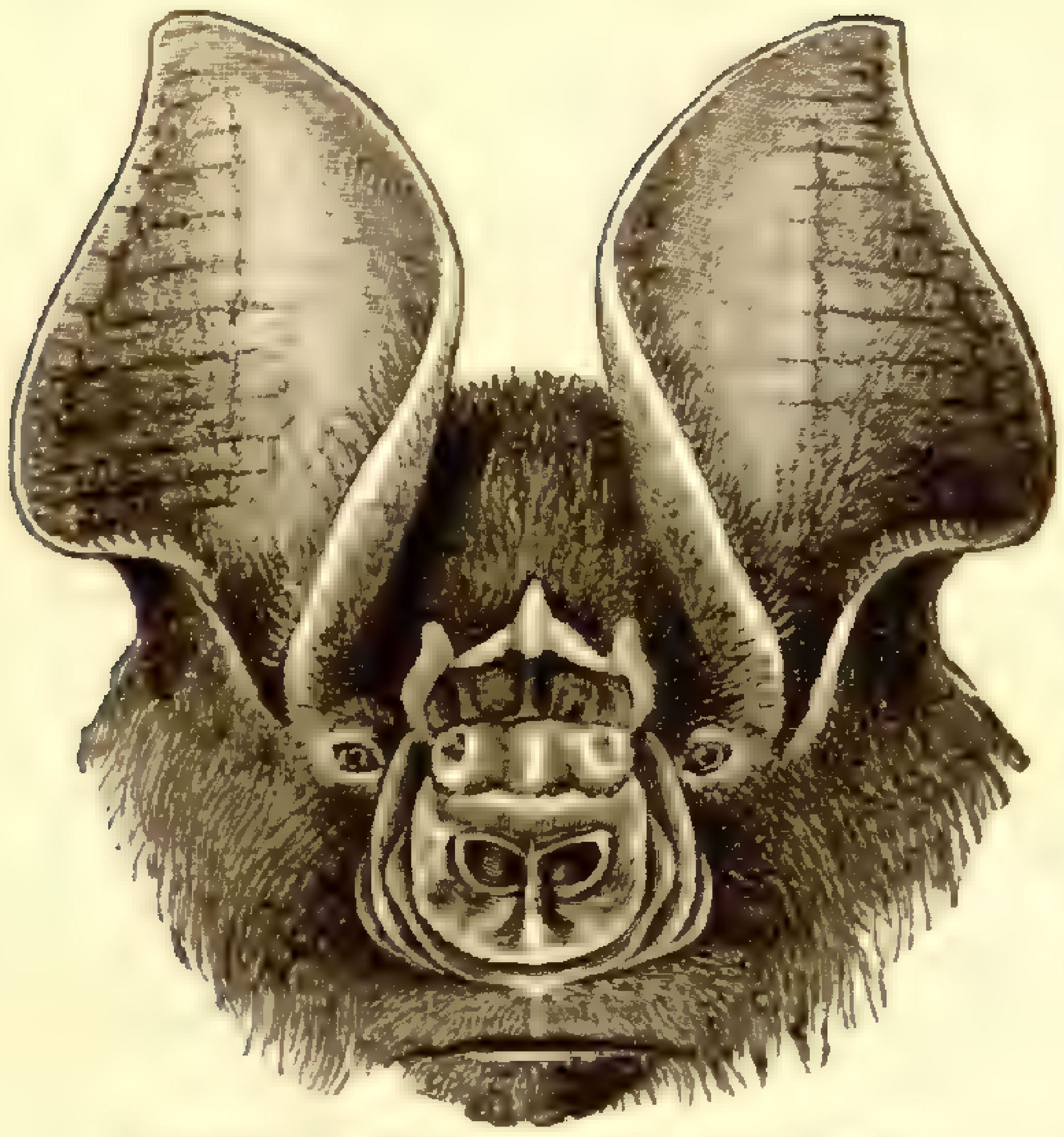

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DR. H. C. HOVEY, in an article in the *Scientific American* of August 29th, says: "A remarkable paper was read at the Washington meeting of the A. A. A. S. by Prof. A. E. Foote, of Philadelphia, describing a new locality for meteoric iron, near Cañon Diablo, Arizona, fragments of which contained diamonds. . . . . . Small meteoric fragments, numbering 131 in all, ranging in weight from one-sixteenth of an ounce to six pounds ten ounces, were scattered over an area about a third of a mile in length and one hundred and twenty feet wide, and extending northwest and southeast. . . . . Exactly in line, but about two miles southeast, were found two large masses, one weighing 154 pounds and the other 201 pounds, which were on exhibition, both of them deeply pitted and the larger one perforated in three places. About 200 pounds of angular oxidized fragments, also of meteoric origin, were found near the base of the crater, a few of which showed a greenish stain from oxidized nickel. . . . . A fragment of a mass weighing 40 pounds was examined by Prof. G. A. Koenig, who found it to be extremely hard, a day and a half being taken in making a section. An emery wheel was ruined in trying to polish the section. This led to closer inspection of certain exposed cavities, where small black diamonds were found. . . . . . The fact of special interest may be accepted as proved,—that diamonds have been found in meteoric fragments. The specimens were carefully examined by the geologists present at the reading of Prof. Foote's paper, and while there were many opinions expressed as to the so-called "crater," and as to its relation to the meteor, none doubted the genuineness of the diamonds."

COMPLETE MASSES of these "shooting stars," from 50c. per mass upwards. Oxidized portions, 10c. upwards. Polished and etched, 25 per cent. higher.

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During the past year we have published the most complete lists on the following subjects: Botany, Entomology, Geology, Geological Surveys, Chemistry, Agriculture, Horticulture, Forestry, etc. Other scientific subjects were issued previously, including medical. Lists sent free on application; please mention the subject in which you are interested. Proceedings Academy of Natural Sciences, 1853 to 1889, $10.00. Baird, Brewer, and Ridgway, "Land Birds," 3 vols., 1874, $20.00. Baird, Cassin, and Lawrence, "Birds of North America," 100 plates, plain, $5.00; colored, $10.00.

A. E. FOOTE,

4116 ELM AVENUE, - - - - PHILADELPHIA, PA.

THE

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A REPLY TO PROFESSOR MARSH'S "NOTE ON MESOZOIC MAMMALIA."[1]

BY PROF. HENRY F. OSBORN.

"OF more than a thousand specimens of Cretaceous mammals on which my investigations are based he has not seen a single one, and no others are known, except a few fragments."

In the above paragraph Professor Marsh refers to the fact, also stated very distinctly in my review of his "Discovery of Cretaceous Mammalia,"[2] that I had not examined his material, and implies that my criticism is of less value because based solely upon his descriptions and figures. This, I may explain, was not from any lack of appreciation of the importance of studying type-specimens, but because these types, together with the other large mammalian collections belonging to the government, are not accessible to American paleontologists. I should certainly have examined them if I could have done so under conditions[3] similar to those in which specimens belonging to the various foreign museums are made accessible to others and myself.

[1] This "Note" is a reply to an article entitled "A Review of the Cretaceous Mammalia," by Henry F. Obsorn. Proc. Acad. Nat. Sc., Phila., 1891; and was read before Geological Section, A. A. A. S., Washington, D. C., August 21st, 1891.

[2] The original unaltered copy of "Note on Mesozoic Mammalia," as privately printed and distributed abroad, was reprinted in the AMERICAN NATURALIST for July, with the original copy of the "Review." For the amended "Note" see Proc. Acad. Nat. Sc., Phila.

[3] In former papers I have made full acknowledgments of the opportunities afforded me by Professor Marsh for examining his types. Such were also extended to me in connection with the Cretaceous mammals, but under conditions which I could not accept.

Without question, these and all other U. S. Geological Survey types, now that they have been described and figured by the author, should be placed in the National Museum, where they could be studied under the ordinary museum restrictions. The examination of type specimens which the author regards "as a matter of courtesy" is rather a matter of custom and necessity; especially is this true where the types are not private but public property, and have been employed in official reports.

Nevertheless, after carefully reading the author's "Note," I am more confident than before that an examination of the types will fully confirm all the main points raised in my review. As the "Note" contains very little in the nature of direct consideration of my criticisms, I had not intended to answer it; but my attention has been called to the probability that, like the author's original papers on the Cretaceous Mammalia, this one might have considerable weight with naturalists who happen to be entirely unfamiliar with the morphology and literature of the Mesozoic Mammalia. We find two features in the "Note": first, a number of definite statements in regard to the structure and classification of the Mesozoic mammals which bear directly upon this discussion,—these I shall now consider and answer; second, a number of unfavorable but indefinite comments upon the character and methods exhibited in my paleontological papers. To the latter I shall make no reply, because, if these papers are of no value, my personal statement to the contrary would have no weight; moreover, such discussion would merely divert attention from the real question at issue, as raised in my review,—viz., the character of the evidence advanced by Professor Marsh for the existence of a very numerous and highly varied Cretaceous fauna. Of the twelve specific statements made by the author in his "Note," four are in defence of his "Cretaceous Mammals," eight are in criticism of alleged errors in my papers upon the Jurassic and Triassic mammals, especially in the "Memoir Upon the Structure and Classification of the Mesozoic Mammalia." I may first reply to the latter.

1. It is first stated that I separated Dromotherium from Microconodon upon insufficient grounds, and figured the type of the

latter genus inaccurately.[4] I would say, in reply, that Microconodon is entirely distinct from Dromotherium in the structure both of the teeth and jaws, excepting only in the imperfect division of the molar fangs, which in this instance is not a generic but at the least a subordinal character. The figure of *Dromotherium sylvestre* was drawn with the utmost care, yet I will be glad to correct any inaccuracies if the author will kindly point them out.

2. That I attributed a pineal foramen and eye to Tritylodon, and later was compelled to retract it. The facts are that in a note to *Science* I based this suggestion upon Owen's figure and description of an apparent "fontanelle" between the parietals and frontals. At the same time I wrote to the British Museum asking Dr. Baur to make a careful examination of the skull itself, and, upon my learning that there was no foramen, I immediately published a correction in *Science*,[6] and moreover withdrew the suggestion in my memoir.[5]

3. That my figure of Phascolotherium was inaccurate in four important points. In reply, I may say that three years ago I published[7] a correction of the only error in this figure,—viz., the elevated position of the dental foramen. In regard to all three other inaccuracies the author of the "Note" is mistaken: 1. As may be seen by reference to Flower & Lydekker's recent work,[8] the first incisor is present; 2. The mylohyoid groove is correctly figured, as may be seen by comparison with figures published by Owen and others; 3. As stated in the explanation of the plates, the last molar was restored from Dr. Buckland's figure,[9] which was made before this tooth was detached and lost,—a perfectly legitimate proceeding.

4. That I misquoted the title of "Discovery of Cretaceous Mammalia." This is the only point in which the author is entirely correct. I find that inadvertently the article "the" was included in quotation marks.

[4] "Mesozoic Mammalia," p. 222.

[5] "Mesozoic Mammalia," p. 220, foot-note.

[6] "No parietal eye in Tritylodon," *Science*, 1887, p. 538.

[7] Proc. Acad. Nat. Sc., 1888, p. 294.

[8] "Mammals: Living and Extinct," p. 114.

5. That my definition[10] of the Multituberculata (1) omitted some of the characteristic features of this group, and (2) embraced accurately the genus Mastodon. I find that my definition included the only three distinctive and universal characters of this group which were known at the time (1888); in fact, no additional characters have since been published, nor are any mentioned by the author of the "Note." No one, except the author, could confuse my definition with that of the Mastodon, because the Multituberculata was placed as a suborder of the Marsupialia. The best criterion of the clearness and sufficiency of this definition is that the term defined has been universally adopted in subsequent official and standard publications (see Flower, Lydekker, Trouessart, Döderlein, Ameghino, and others).

6. That I overlooked the strong probability that the type of Bolodon is an upper jaw of a species of Plagiaulax, and made it the type of a new family. The fact is, that so far from overlooking the resemblance between Bolodon and Plagiaulax, I have given the fullest discussion which has ever been published[11] of the evidence for and against the union of these forms into one genus and family. The author, moreover, does not mention that the latest expression of opinion upon the subject is his own, and in favor of the very views he is here criticising, as shown in the following sentence: "These fossils evidently belong to the family named by the writer (*i.e.*, by Marsh) the Allodontidæ, which includes the American genus Allodon, and Bolodon from the Jurassic of England."[12]

7. That I have overlooked the probability that the type of Stereognathus is an upper jaw, although heretofore described as a lower one. Nothing can be said in support of such a probability. The universal opinion of English writers, following the exceptionally careful figures and descriptions of Charlesworth and Owen, is that this type is a lower jaw. I have not examined

[9] Op. cit., Fig. 29.

[10] "Mesozoic Mammalia," p. 213.

[11] "Mesozoic Mammalia," p. 217.

[12] A. C. Marsh, *Amer. Jour. Sci.*, p. 179. See also same journal, April, 1887, p. 329.

the type itself, but even since the author's suggestion [13] that the type is part of a maxilla it is again described and figured as a lower jaw in Flower and Lydekker's "Mammals." [14]

8. That I followed Cope's error in founding the genus Meniscoëssus upon a supposed premolar, which is, in fact, a reptilian tooth. It is distinctly stated in my review, as well as in Cope's original description, that the type of Meniscoëssus is the molar tooth, as is also implied by the term itself.[15] Professor Cope himself expressed serious doubts as to the mammalian nature of the "premolar." When I examined it, finding a basal cingulum and close histological resemblance to the molar, I described it as a premolar, and figured it as a probable premolar. There is, however, reasonable doubt as to its mammalian character, for the basal portion of the crown is entirely wanting, removing all evidence as to the character of the fangs.

9. That I mistook two portions of a fish (Hybodus) tooth, artificially cemented together, for a mammalian premolar. I concluded my description of this tooth in the following way: "If it is actually from the Rhætic beds, it probably represents a premolar of Triglyphus." I thus clearly expressed my doubts as to its reference to a long-established genus, and was far from selecting such a specimen as the type of a new genus and family of mammals, as the author has done in the case of Stagodon.

It thus appears that of these eight alleged errors I have myself long since published corrections of the two relating to Phascolotherium and Tritylodon; that nothing has been added by recent discovery to my definition of the Multituberculata; that my association of the supposed premolars with Meniscoëssus and Triglyphus was in each case accompanied by an expressed doubt, either in the description or figure; finally, that my conclusions regarding the Bolodontidæ (Allodontidæ), if erroneous, have nevertheless been adopted and supported by the author himself. The author's criticisms will therefore have little weight with persons who

[13] *Amer. Jour. Sci.*, April, 1887, p. 343.

[14] P. 110, Fig. 27.

[15] The question of this nomenclature is fully discussed in the AMERICAN NATURALIST, July, 1891.

are fully familiar with the literature of this subject.[16] Let us now consider the four points which the author has advanced in reply to my review of his determinations of twenty-seven distinct types.

1. First, as regards the types of the genus Stagodon and family Stagodontidæ, the author still considers them as mammalian teeth, and remarks: "I distinctly stated that this tooth has two fangs, and the bases of these were indicated in one of my figures." As this point is an interesting one, I reproduce for a second time the figures of the teeth which were selected as the

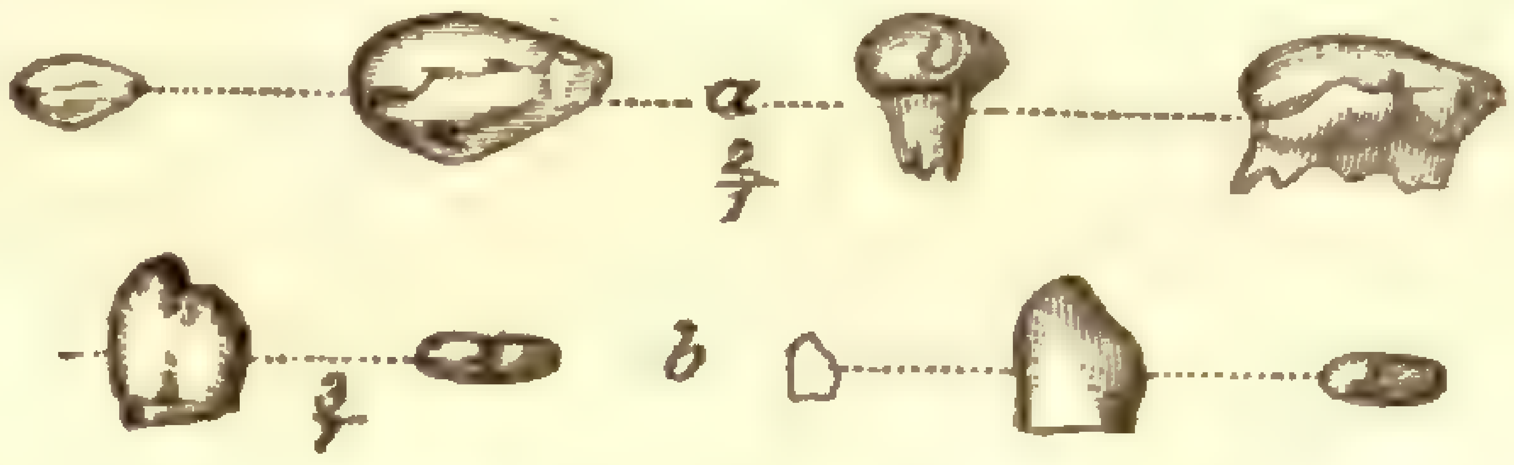

FIG. 1.—(STAGODONTIDÆ.) *a*, *Stagodon nitor*. AfterMarsh. Types. *b*, *Platacodon nanus*, After Marsh. Types.

types of Stagodon, and allow the reader to judge. We must direct our attention only to these types, remembering that the other teeth were all found isolated, and the fact, as urged by the author, that "other teeth described as premolars," and "well-preserved specimens since obtained" show distinct fangs, has no bearing upon the question, since the association of these teeth with the types is purely conjectural.

2. The order "Allotheria." The author claims that he has defined it, that it is prior to Multituberculata, and should be adopted. There is no question as to the priority of definition of the Allotheria; let us consider the character and applicability of the definition. A fundamental objection to this term, as well as to Pantotheria, is that Gill and Huxley had previously employed the termination *theria* for the three great subclasses of Mammalia (represented to-day by the Monotremata, Marsupialia, and Placentalia); the termination had thus acquired a distinctive and useful subclass rank. Even, therefore, if Allŏtheria had been properly defined, it could not well be adopted for a group which

[16] I have found a number of errors in my writings upon the Mesozoic mammals which are not in the author's list. I have also taken great care in every instance to publish corrections of them as soon as discovered.

constitutes at most an order included in the Prototheria or Metatheria. We may consider it fortunate, therefore, that the term was not given a distinctive ordinal definition, but one which, upon the author's own statement,[17] failed to separate it from the Marsupialia,—viz: 1. Teeth much below normal number; 2. canine teeth wanting; 3. Premolar and molar teeth specialized; 4. Angle of lower jaw distinctly inflected; 5. Mylohyoid groove wanting. The best criterion of the definition and of the inutility of this term Allotheria is the fact that it has been rejected by every subsequent writer.

The third and fourth points advanced by the author in reply are extremely comprehensive, and, if they can be substantiated, will to some extent invalidate my criticism. It will be observed, however, that both points are advanced very cautiously.

3. He states that "no true Plagiaulacidæ are known with three rows of tubercles upon the upper molars." This is equivalent to saying that we have no positive evidence that the upper molars have three rows; it is not stated by the author that any upper Plagiaulax molar is *known* with two rows. I may recall the fact that in my review I called attention to this lack of positive evidence, and enumerated the strong cases of indirect evidence to the contrary which we find, first, in the association of loose molars of three rows of tubercles with the lower jaws of Neoplagiaulax, not to speak of Cimolomys; second, in the three rows of the maxillary molars of Polymastodon, a genus very closely related to Plagiaulax; third, in the analogy of Tritylodon. I consider this indirect evidence so strong that it is very unlikely to be refuted by subsequent discovery, and believe that the author will never be able to substantiate this first statement.

4. Finally, he states that "no Allotheria (Multituberculata) are known with certainty to have three rows of tubercles in the lower molars." In support of this cautious assertion, the author first refers to the type of Stereognathus as probably a portion of a maxilla; this probability we have already shown rests upon no stated evidence whatever. He observes, secondly, that "there is now conclusive evidence that the Cretaceous molar teeth with

[17] *Amer. Jour. of Science*, 1880, p. 239.

three rows of crescentic tubercles belong to the upper series, as I have described them."

In reply, I may say that undoubtedly some crescentic tubercular teeth, in three rows, will be found in the upper jaws of some Cretaceous species, if for no other reason, because the ancestors of Polymastodon will be found in the Cretaceous, and these ancestors will exhibit three rows of subcrescentic tubercles in the upper molars, since such is the character of the large Polymastodon upper molars.

It remains for the author to show specifically that the types of Selenacodon and Tripriodon are maxillary teeth. I should myself have considered them as such but for the fact that the type of *Dipriodon robustus*, with two rows of tubercles, was described as a maxillary tooth, and figured with a supposed fragment of the zygomatic arch attached to the alveolar border. If this tooth proves to be mandibular, and the molars with three rows of crescents are shown to be maxillary, the author will have substantiated his second statement; but such proof will not help him out of his synonomic dilemma, for it will still appear that he has founded three families, five genera, and as many species upon different teeth belonging to the same dental series, and all synonyms of Meniscoëssus.

Enough has been said to make it clear that, whatever evidence the author may hold in reserve for his future memoir, this "Note on Mesozoic Mammalia" contains no positive evidence in defence of his "Cretaceous Mammalia."

In closing, I may quote a concluding paragraph in the author's reply: "No one who has earnest work to do can afford to spend time in the ungracious task of pointing out errors in the work of others." I have always been of the same opinion that criticism is an ungracious and thankless task. In this case I deferred my "Review" for nearly two years, and endeavored to avoid it entirely by sending to the author all my main points of doubt in regard to his paper, and asking him to revise it. After waiting for the author to avail himself of this opportunity, I came to the conclusion that the "Cretaceous Mammals," sent out with the authority of the distinguished author's name, and under the

auspices of our National Survey, might spread abroad a score of synonyms which, finding their way into literature, it would require years to eliminate. I am happy to see, however, that all recent writers, guided by their own critical faculty, and in some measure perhaps by my "Review," have taken from the two papers on "Discovery of Cretaceous Mammals" only what they actually contain,—namely, valuable and interesting additional characters of two or three multituberculate genera, already partly known, besides the discovery of two small trituberculates, and have not recognized the four orders, eight families, sixteen new genera, and twenty-seven new species constituted by the author.

HEMLOCK AND PARSLEY.

BY W. W. BAILEY.

THE study of the order Umbelliferæ presents peculiar difficulties to the beginner, for the flowers are uniformly small, and strikingly similar throughout the large and very natural group. The family distinctions or features are quite pronounced and unmistakable, and it is the determination of the genera which presents obstacles, — serious, indeed, but not insurmountable. "By their fruits shall ye know them."

The Umbelliferæ, as we see them here, are herbaceous, with hollow, often striated stems, usually more or less divided leaves, and no stipules. Occasionally we meet a genus, like Eryngium or Hydrocotyle, with leaves merely toothed or lobed. The petioles are expanded into sheaths; hence the leaves wither on the stem. The flowers are usually arranged in simple or compound umbels, and the main and subordinate clusters may or may not be provided with involucres and involucels. To this mode of arrangement there are exceptions. In marsh-penny-wort (Hydrocotyle) the umbels are in the axils of the leaves, and scarcely noticeable; in Eryngium and Sanicula they are in heads. The calyx is coherent with the two-celled ovary, and the border is either obsolete or much reduced. There are five petals inserted on the ovary, and external to a fleshy disk. Each petal has its tip inflexed, giving it an obcordate appearance. The common colors of the corolla are white, yellow, or some shade of blue. Alternating with the petals, and inserted with them, are the five stamens.

The fruit, upon which so much stress is laid in the study of the family, is compound, of two similar parts or carpels, each of which contains a seed. In ripening, the parts separate, and hang divergent from a hair-like prolongation of the receptacle known as the gynophore. Each half fruit (mericarp) is tipped by a persistent style, and marked by vertical ribs, between or under which lie, in many genera, the oil-tubes or vittæ. These are channels

containing aromatic and volatile oil. In examination the botanist makes delicate cross-sections of these fruits under a dissecting microscope, and by the shape of the fruit and seed within, and by the number and position of the ribs and oil-tubes, is able to locate the genus. It of course requires skill and experience to do this, but any commonly intelligent class can learn the process. It goes without saying, and as a corollary to what has already been stated, that these plants should always be collected in full fruit; the flowers are comparatively unimportant. Any botanist would be justified in declining to name one of the family not in fruit. An attempt would often be mere guesswork.

In this family is found the poison hemlock (Conium) used by the ancient Greeks for the elimination of politicians. It is a powerful poison. The whole plant has a curious mousy odor. It is of European origin. Our water hemlock is equally poisonous, and much more common. It is the *Cicuta maculata* of the swamps,—a tall, coarse plant which has given rise to many sad accidents. *Æthusa cynapium*, another poisonous plant, known as "fool's parsley," is not uncommon, and certainly looks much like parsley. This only goes to show how difficult it is for any but the trained botanist to detect differences in this group of plants. Side by side may be growing two specimens, to the ordinary eye precisely alike, yet the one will be innocent and the other poisonous.

The drug assafœtida is a product of this order. All the plants appear to "form three different principles: the first, a watery acid matter; the second, a gum-resinous, milky substance; and the third, an aromatic, oily secretion. When the first of these predominates they are poisonous; the second in excess converts them into stimulants; the absence of the two renders them useful as esculents; the third causes them to be pleasant condiments." So that besides the noxious plants there is a long range of useful vegetables, as parsnips, parsley, carrots, fennel, dill, anise, caraway, cummin, coriander, and celery. The last, in its wild state, is said to be pernicious, but etiolation changes the products and renders them harmless. The flowers of all are too minute to be individually pretty, but every one knows how charming are the

umbels of our wild carrot, resembling as they do the choicest old lace. Frequently the carrot has one central maroon-colored floret.

Though most of the plants are herbs, Dr. Welwitsch found in Africa a tree-like one, with a stem one to two feet thick, much prized by the natives for its medicinal properties, and also valuable for its timber. In Kamschatka also they assume a sub-arboreous type, as well as on the steppes of Afghanistan.

As mistakes often occur by confounding the roots of Umbelliferæ with those of horse-radish or other esculents, it is well, when in doubt, to send the plants, *always in fruit*, if possible, for identification. None of them are poisonous to the touch,—at least to ordinary people. Cases of rather doubtful authenticity are reported from time to time of injury from the handling of wild carrot. We have always suspected the proximity of poison ivy; still, it is unwise to dogmatize on such matters. Some people cannot eat strawberries—more's the pity!—while the rest of us get along with them very happily. Lately the *Primula obconica* has acquired an evil reputation as an irritant, so there is no telling what may not happen with certain constitutions.

Difficult as is the study of Umbelliferæ, it becomes fascinating on acquaintance. To hunt up a plant and name it by so scientific a process brings to the student a sufficient reward.

Providence, Rhode Island, July 2d, 1891.

THE PROBLEM OF THE SOARING BIRDS.

BY I. LANCASTER.

SAYS Darwin, in the naturalist's voyage around the world: "When the condors are wheeling in a flock round and round any spot, their flight is beautiful. Except when rising from the ground, I do not recollect ever having seen one of these birds flap its wings. Near Lima I watched several for nearly half an hour, without once taking off my eyes: they moved in large curves, sweeping in circles, descending and ascending without giving a single flap. As they glided close over my head, I intently watched from an oblique position the outlines of the separate and great terminal feathers of each wing; and these separate feathers, if there had been the least vibratory movement, would have appeared as if blended together; but they were seen distinct against the blue sky. The head and neck were moved frequently, and apparently with force; and the extended wings seemed to form the fulcrum on which the movements of the neck, body, and tail acted. If the bird wished to descend, the wings were for a moment collapsed; and when again expanded with an altered inclination, the momentum gained by the rapid descent seemed to urge the bird upwards with the even and steady movement of a paper kite. In the case of any bird *soaring*, its motion must be sufficiently rapid so that the action of the inclined surface of its body on the atmosphere may counterbalance its gravity. The force to keep up the momentum of a body moving in a horizontal plane in the air (in which there is so little friction) cannot be great, and this force is all that is wanted. The movement of the neck and body of the condor, we must suppose, is sufficient for this. However this may be, it is truly wonderful and beautiful to see so great a bird, hour after hour, without any apparent exertion, wheeling and gliding over mountain and river."

The above remarkable words for many years have served to sustain my interest in the endeavor to substitute the actual for his provisional solution of soaring flight.

I presented in this magazine certain papers of a suggestive character, the results of much observation and experiment, in the hope of directing attention to curious facts, not recognized, bearing upon this subject. Three years ago I moved to my present location, Egeria, Colorado, where, during the past eighteen months, I have done the principal work necessary for this undertaking.

I consider myself successful in obtaining important results. In this paper I propose dealing with an experiment so obviously simple, as it now stands, that I am dazed to think of the labor that has been expended upon it. This device, in wind, really exhibits the entire soaring case in a very concise way, so far as its fundamental principles are concerned; but I give briefly the same experiment in calm air, as supplementary. The first form of the experiment can be tried by any one with a fair amount of constructive ability, and it cuts an awful chasm through the teachings of the mechanical schools on atmospheric resistance, and unerringly points to practical air navigation.

A rough-board platform, about twelve feet square, with a post and cross-beam fixed upon it, the whole being capable of horizontal rotation to present the plane to the wind from whatever direction it might blow, is the framework.

The plane should be a flat pyramid,—5x5 feet square is a good size on the base, and two inches high. The edges of such shape, being sharp, give the effect of a true plane without thickness. The whole should be finished smooth, similar to the top of an ordinary piano. Perfectly seasoned white pine or red cedar is an excellent material to use, glueing thin strips together in the rough, and dressing to shape.

To one edge of the plane two fine steel wires are fastened, which are suspended from two ordinary spring balances, fixed by their rings to the cross-beam of the platform. When thus suspended the plane will sway freely too and fro, like a child's swing, the flat side being in a vertical position when at rest.

To the apex at the back of the plane is fixed another wire provided with another spring balance, the ring of which is fastened to the rear part of the cross-beam, when the plane is drawn back-

ward to any desired angle of obliquity with the horizon. This wire must in all cases be kept perpendicular, and the other two parallel to the plane.

It is obvious that the plane can be pulled backwards through all degrees of the quadrant, and suspended at any position by the wires and balances in a state of rest. While the plane hangs vertically all its weight will be on the parallel wires, half on each. As it is pulled to the rear less and less weight will be on the parallel wires, and more and more on the normal wire, until at a horizontal position, 90° from the starting point, all weight will be on the normal wire, and none on the parallel.

If we assume the soaring inclination of a bird to be 5° from horizontal, and pull the plane back to that angle, the normal scale will mark twenty-seven pounds and the parallel one pound each, small fractions of weight being neglected. If an angle of 45° be used, the normal scale will mark about nineteen pounds and the two others 9½ pounds each.

FIG. 1.

To operate this device, a time of calm air is chosen, and the plane is pulled back to any desired angle, say 45°, the normal scale fastened in position, and the weight indications of each scale noted. When wind arises, rotate the platform to face it, so that the plane will stand squarely across its direction. This is not done to expose the plane to any particular direction of wind, but to get all the resistance possible out of it. Then observe the scales to see what effect wind has on the normal and parallel gravity stresses. Any perceptible breeze will be shown by the normal scale, which will indicate less and less weight as wind increases. If the air moves with sufficient force, all weight will

be taken from the normal scale, the wire may be cut, and the plane will rest on the air pressure beneath its surface, in which event pressure is substituted for tension on the normal line, otherwise the stress being unchanged, either in direction or magnitude.

If the plane be suspended at the soaring angle of 5°, and wind is strong enough to lift it to that angle, all tension will be taken from the normal scale, the plane resting on air pressure as at the 45° inclination, and so on through all degrees of the arc.

During all this time the parallel scales indicate the weight recorded by them at the various angles in calm air, so that they are not influenced by wind in the least degree, however great its force might be.

If at any angle of obliquity the plane be held by a wire from each corner, perpendicular to it, and fastened to the platform, no force of wind will vary the parallel scales, the tension of the four wires holding the entire wind resistance, however great, In short, there is no way to get wind to affect the parallel scales. If variation in them occurs, it shows at once some error in the experiment, either the wires being out of adjustment, or some warpage of plane or other disturbance having taken place.

The rotating arms for trying this experiment in calm air are 60 feet radius, their ends describing a circle of 120 feet diameter. The plane is hung under the arm, and all the conditions of the other experiment complied with. No change could be noted in the results, excepting that motions of plane were made with greater smoothness, on account of greater steadiness in artificial wind. By no means could air resistance be brought to bear on the parallel component of gravity. It acted the same in wind as in calm air, undisturbed by atmospheric resistance.

Before anything is inferred from these experiments it will be best to state the facts of the case. So completely subversive of the usual conceptions of the action of air on surfaces is this trial that it seems imperative to get the facts right before attempting to range them in the order of mechanical sequence.

For convenience, I will number a few of the conspicuous ones.

1. The scales, being marked in half pounds, do not register

small fractions of force, so that if there be friction down the plane caused by slipping air, such resistance would act on the parallel scales, but, being of small magnitude, could not be read from the index.

2. Neither the cross-arm in wind, nor the rotating arm in calm air, holds the plane against the air. They simply neutralize the parallel factor of gravity, and prevent its acting upon the plane.

3. The normal gravity component does work upon the air by disturbing it in various ways, such as changing its motion, and condensing it, and it is the only fraction of weight that meets with atmospheric resistance, if we neglect the unknown elements of friction.

4. The experiments are in obedience to the law of normal resistance of fluids to surfaces compressing them.

5. There is no resistance to the plane on the line of motion of either plane or air. Even the hypothetical friction is not on such line.

6. Wind or calm air produce identical results; the only requirement being that air and plane shall meet, motion of either, related to the earth, being indifferent.

The consequences flowing from the above are many and important, and in the briefest manner I will notice those which seem to demand the earnest attention of every student of nature, however abhorrent they may be to text-book devotees.

It is obvious that the wires of the experiment, when the plane is adjusted to any obliquity in calm air, resolves weight in the same way that an ordinary inclined plane would if the latter were rough, the stresses being of the nature of pressure instead of tension.

Then we have in the mathematical formula of inclined planes without friction what also applies to oblique atmospheric resistance. For when the plane of the experiment, held by the wires, is submitted to air pressure, the shape, size, and obliquity of that plane determines the shape, size, and obliquity of the plane of air pressure beneath it, which plane being destitute of friction the component along it must be neutralized, as is done by the paral-

lel wires, to preserve stability; otherwise, the experimental plane would slip down the air plane.

It follows that atmospheric resistance is a purely static feature in all cases; as completely so as a rigid inclined plane, resolving all forces impinging upon it. This becomes still more evident when we see that it is the experimental plane that determines the direction of air resistance, and not the direction in which plane and air meet. If air moved vertically upwards, or from the rear, or from any other direction, against the lower surface, the direction of resistance would be unchanged, and the experiment equally effective. It was not to employ horizontal wind that the experiment was arranged, but to parallel the case with a soaring bird, the working force of which is gravity.

Magnitude of resistance would vary, with the same wind, as its direction approached or receded from the normal line, but, as will be shown farther on, magnitude is unimportant, direction being the vital matter.

If the experimental plane were supposed to be of the same specific gravity as the air it displaces, and some other force used to hold the plane against, or drive it upon air, the same result would follow. This force would be resolved, as gravity is resolved, by the air plane.

The enormous error of the mechanical schools in estimating resistance of air to oblique surfaces is now conspicuous. This error has the sanction of the great name of Newton, and stands squarely across the pathway leading to artificial air navigation, setting up scarecrows along every avenue to success.

But it is consoling to know that no man, not even a Newton, can diagram a force into nature that was not there before the diagram was made.

The entire nature of air resistance is misconceived. The case is a curious one of *bouleversement.* The activities are turned upside down. Instead of the surface resolving the resistance, it is the resistance that resolves whatever forces drive the surface upon it. I have examined over a hundred text-books of mechanical teaching, and have found no exception to the prevalence of this error. They all get resistance on the line in which

plane and air meet. They do not all go about it in the same way, but in the end that is where they locate it. So far as I can determine, the error is on the increase, the later authorities being more emphatically astray than the earlier ones. The last utterance that I have seen is contained in a lecture delivered to the students of Sibly College, Cornell University, in May, 1890, by O. Chanute, C.E. On pages 28 and 29 of the published paper the error comes out glaringly. In speaking of M. Drzewieki's work on Duchemin's formula, he says: "Next he calculates the horizontal components of the normal pressure, this being the resistance to the advancement of the plane." His entire exposition is saturated with the blunder, for no horizontal resistance exists. Mr. S. P. Langley, in his recent submission of experiments and suggestions in aërodynamics, entertains the same delusion in its full force, otherwise he seems notably free from a priori bias.

But my thanks are due to some unknown friend who has just sent me a copy of *Science*, dated May 1st, 1891, in which I find marked a letter to the editor on "Flying Machines," by H. A. Hazen. The writer is wholly unknown to me; but I infer that he is neither a "crank" nor a dabbler in science, but a well-grounded expert of wholly intelligent attainments. Without presuming to defend Mr. Langley in the remotest manner, I am justified in holding that Hazen's statements are accepted by the mechanical schools, and I herewith call attention to the utterly erroneous nature of such teaching by contrast to the following facts.

1. A bird does support itself in soaring flight by going fast, and in no other way.

2. There is no evidence that a bird in the act of soaring ever remained stationary in still air for an instant; and whether air is hurled against bird or bird against air, the result is the same; meeting in opposition of bird and air is required by the very nature of soaring flight.

3. "Solution of the problem" is unchanged by "great velocity."

4. As parallel motion on the upward slant is what gives "velocity" to the bird, and as atmospheric friction is the only

resistance to such translation, speed of flight is determined by a force which may, for all practical purposes, be left wholly out of the account.

5. "As a matter of fact," the statement that "it would be much easier to go slow than fast" is a burlesque.

6. Resistance of air at one mile or one hundred miles per hour is practically the same.

So far as I can see, the paraphrased arguments of LeConte do not touch the problem of soaring flight in any way, but all the errors of the mechanical schools are evidently adopted by him.

But here is by no means the end of this catena of difficulty.

There are three ways, shown in the subjoined diagram, in which a surface and air can meet.

1. Parallel to the surface.
2. Obliquely to the surface.
3. Normal to the surface.

The first meets with frictional resistance.

The second with both friction and pressure.

The third with pressure resistance only.

The direction of the first and third resistance is in the line on which plane and air meet, there being a single stress on that line. The directions of the second resistances are both parallel, and normal to the plane, there being two stresses perpendicular to each other, and no stress on the line in which plane and air meet.

It directly follows that direction of motion of the second case is a resultant, composed of two velocities, one on the line of frictional, the other on the line of pressure resistance, the plane being a body subject to two forces, neither of which are in the line of motion.

No single force, however great, could drive a plane obliquely through air. There must of necessity be not less than two stresses, derived either from the application of two forces, or the resolution into two components of one.

I need go no further in this direction, but will add a few words regarding my work during the past year and a half, in the way of direct flight.

It is sufficiently obvious that a force of about two pounds' constant pressure applied to the plane, either in wind or calm air, in the above experiments, to take the place of the cross-arm and rotating arm, neutralizing the parallel component of gravity, would, if obtained from the constant flow of twenty-seven pounds pressure escaping from beneath the surface, produce a true soaring plane in calm and wind.

A smooth plane has no tendency to throw two pounds of this twenty-seven pounds (over 90°) against the obstructive component.

The true problem of flight consists in so manipulating the surface as to perform this function. I have hitherto taken the wing of a soaring bird as a model, and have had unexpected and most gratifying success.

I can produce true soaring flight in natural wind with a plane exceeding two pounds to a square foot of surface whenever I wish to do so and can obtain wind strong enough for the purpose. During the above-mentioned period of time I have made about fifty planes of various shapes and sizes, and from 25 to 400 pounds in weight. These planes are not set free in wind, but used as in the experimental cases above, with rigid rods in place of the parallel wires. These rods run in large rings and have a cross head at their outer ends, allowing the plane to run to the front until its edge rests against the rings. In the best trials the parallel component is neutralized at 10° from horizontal, far exceeding my expectations derived from observations of the birds; their angle of obliquity being rarely over 5°.

On a few occasions these planes accidentally escaped me in time of highest wind, and were ruined at once for all purposes excepting fire-wood; in each case being a loss of two or three months' work, and playing havoc with my finances. One that I

valued particularly plunged to the front in a violent blast of wind with force sufficient to tear out the rings. It rose into the air gradually higher and higher, until an elevation of at least 3,000 feet was attained, when some part of the device giving away it lost equilibrium, and plunged through the air, striking the earth about two-and-a-half miles from the starting point, and 1000 feet higher than that locality. Another mile would have carried it to the summit of the Flat Top Mountains. It was in the air about three hours, and I walked beneath it during its flight. Its course was directly against the highest wind I have experienced during my residence here. At times it did not progress, but went higher. It weighed one hundred and ten pounds, and had been well balanced for experimenting on surface manipulation. There was no lesson taught in this flight, the birds having been doing the same thing for a long time. It was an interesting spectacle to look at; so is a large bird in the same act. I presume Mr. Darwin's provisional solution would apply to this plane as well as to the condors, but I am trying to explain the actual mechanical activity of both.

The best effects produced were with a plane of 400 pounds weight and eighty square feet of surface. In a wind that would be rightly termed a gale, arising about midnight, this plane was thrown to about 7° from horizontal. It ran to the front against the rings at 10°, where the entire parallel component was neutralized, and at 7° it hugged the rings with a force that required a backward pull of fifteen pounds to detach it.

This plane would make a splendid air navigator, and I would have no hesitation in trusting myself to it when steering, equilibrium, and alighting or stopping items had been worked out. I mean to say that it would navigate wind. I am now just entering on a course of experiments in calm air.

The front ledge is an important factor in steadiness, but the rear curve I have entirely abandoned, surface manipulation being depended upon to produce the parallel thrust. My judgment is that I have succeeded in separating the mechanical devices of a bird's wing which produce flight from those serving other life purposes of the animal. It has been an arduous task. At the

close of experimenting in this line I hit upon a method not exhibited by the birds, which promises best results, but which waits further developments.

Let us suppose a soaring bird of twenty-seven pounds weight, with stretched wings on an angle of 5° from horizontal, translating itself in calm air, or stationary when related to the earth in wind. Suppose, further, the initial impulse to have been made so that its motion is uniform.

Then its weight is resolved into a normal and parallel component by the air plane of pressure beneath it. The normal component does work by driving the air out of place, thereby changing its motion. The parallel component acts upon the bird, tending to drive it on the downward slant, backwards. The air in being condensed reacts in all directions, and reaction towards the front being resisted by the surface manipulations, the bird is driven against friction and the small component, on the upward slant, and, completing the diagram of velocities, the result is horizontal flight.

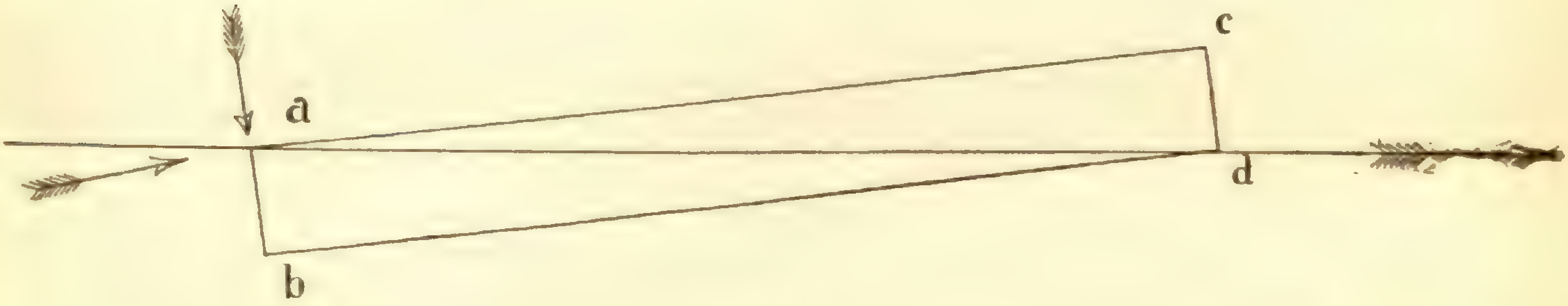

FIG. 2.

If the parallel factor be supposed out of the way by neutralization arising from surface manipulation, and the air to be calm, then the normal factor would drive the plane against air pressure from *a* to *b* in any given unit of time, say one second.

Simultaneously with this motion a small excess of parallel force over that required to balance the parallel factor—say one-half pound constant pressure—would drive the plane from *a* to *c*, against friction, in which case motion would occur on *a d*, the resulting line of horizontal flight.

I have said that direction, and not magnitude of force, was the vital point in the soaring activity. This fact must now be quite

plain. Magnitude of force depends on weight of plane, and on that alone. The gravity stress existing between the plane and the earth's center is the only conceivable force in action, and air will meet any demand made upon it by the normal factor of this force, against which it is a reaction. This factor is determined by the angle of obliquity of plane in each case, and the work done upon the air goes on independently of the parallel motion of the plane on the upward slant, which alone gives a soaring movement. It is obvious that whether wind should move from the zenith downwards, or from the earth vertically upwards, or horizontally, or from any angle of obliquity whatever, the soaring activity is not affected. That goes on as it does in calm air. Motion of plane as related to the earth would of course vary with wind, if inclination remained the same, but the soaring action, considered by itself, is absolutely independent of wind,—meaning by that word motion of air as related to the earth.

I had prepared specimen feathers from the wings of various birds during the past twenty-five years, intending to prepare a paper for publication on the subject of surface manipulation, which I hold to be the most curious and interesting feature about a bird, yet almost paralleled by the wonder that it has hitherto escaped notice. But we have a rat, if it be a rat, that is endowed with a peculiar moral nature. With it, exchange is no robbery. A nest of them inhabited the building in which I kept my specimens, and they bartered what I laid claim to for an indescribable lot of miscellaneous rubbish of no earthly use to me. Their views and mine were very different. They had cut the feathers into small bits and mixed them with dirt, and stowed them away in all sorts of holes and corners. I shut a cat in the room for some days, which caused the rodents to vanish, but my feathers were ruined.

If you will take a primary wing feather of any large bird,—say a wild goose, or especially a frigate bird,—and cut squarely across the ribs, and examine the divided part endwise with a magnifying glass of low power, you will see nature's plan of surface manipulation to get the forward thrust against the small component of weight and air friction. Cut on *b c*, and examine

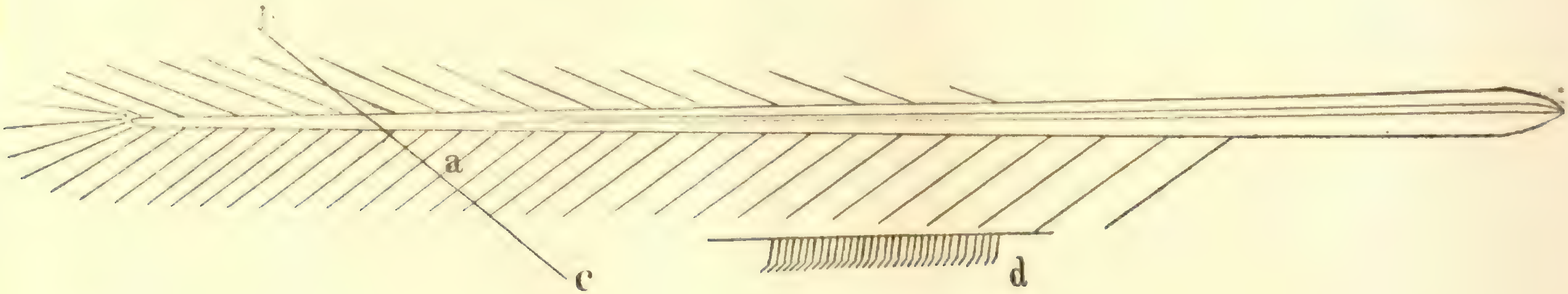

FIG. 3.

the cut ends of the ribs along *a*. You will see something like *d*. If we suppose an unpressed small portion of air to be represented by a small circle o, and the same air when pressed, by a flat disk ⬭, and then mesh this disk with the sort of surface made by the manipulation, the nature of the front thrust will be made thinkable. I enlarge it below. That part of the air particle to

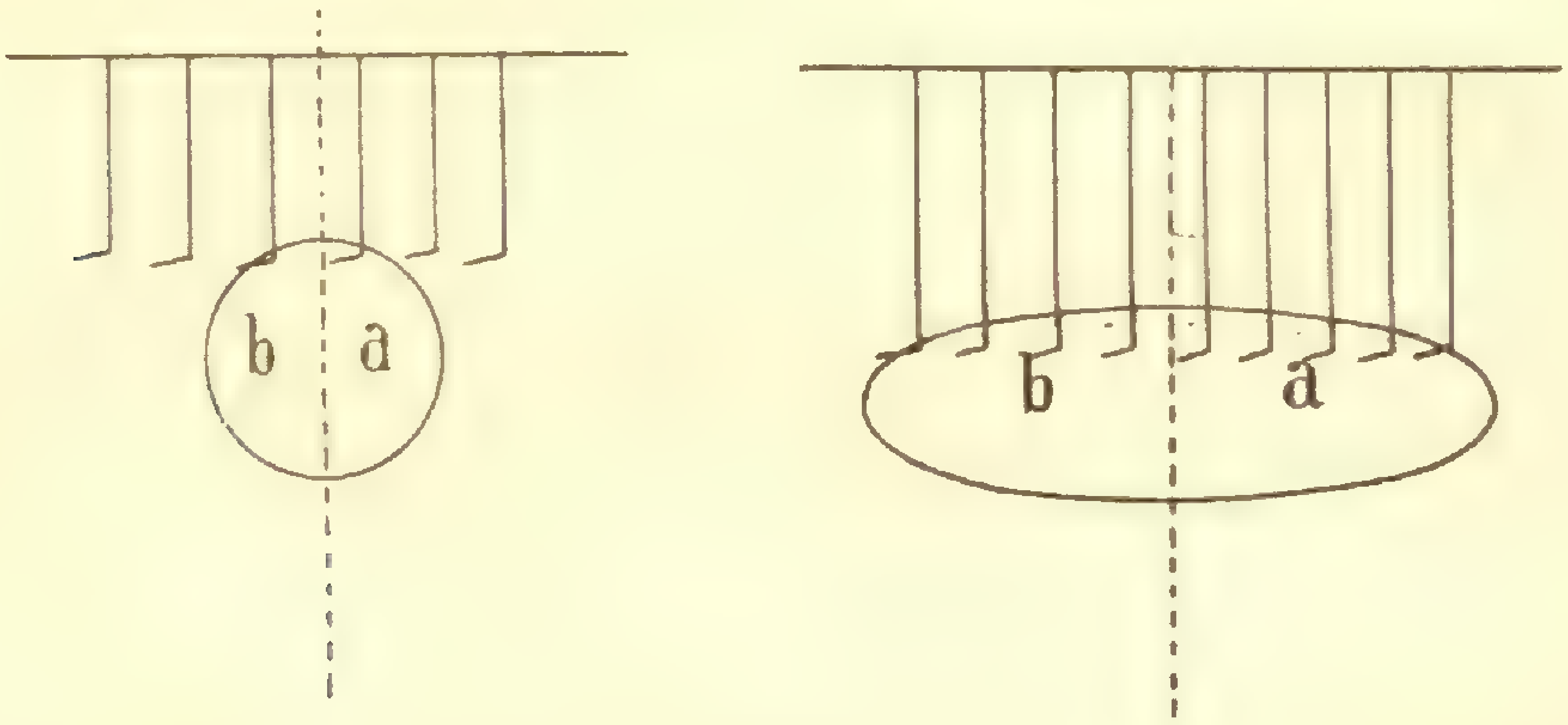

FIG 4.

the rear of the dotted line as *b* slips easily over the ribs, while the front part, *a*, engages with them and tends to carry them to the front. I have worked out all this artificially with excellent results, and can give you a paper upon it if a large part of the actual size and shape of the ribs in different birds is left to memory, as the rats have destroyed my samples.

THE HISTORY OF GARDEN VEGETABLES.

BY E. L. STURTEVANT.

(Continued from page 706, Vol. XXV., 1891.)

Lycopersicum humboldtii Dun.

This is very like the preceding, but the racemes of the flowers smaller, the calycine segments being never the length of the corolla, and the berries one-half smaller, red, and, when cultivated, not less angular than those of *L. esculentum*.[1] It was noticed by Humboldt[2] as under cultivation at La Victoria, Neuva Valencia, and everywhere in the valleys of Aragua, in South America, and is described by Kunth[3] in 1823, and by Willdenow, about 1806, from plants in the Berlin garden from seeds received from Humboldt. The fruit, although small, has a fine flavor. I suspect the Turban, Turk's Cap, or Turk's Turban of our seedsmen, a novelty of 1881, to be referable here, although this cultivated variety is probably a monstrous form.

Lycopersicum pyriforme Dun.

This, which is to be classed as one of the fancy varieties under cultivation, occurs with both yellow, red, and pale yellow or whitish fruit. It was described by Dunal in 1813, and in Persoon's synopsis in 1805.[4] It is mentioned in England in 1819, and both the colors in the United States by Salisbury[5] in 1848. It is liked by some for garnishing and pickling. The common names are pear-shaped and fig.

Lycopersicum pimpinellifolium Dun.

The currant tomato bears its red fruit, somewhat longer than a common currant, or as large as a very large currant, in two-

[1] Don. Gard. and Bot. Dict., IV., 443.
[2] Humboldt. Trav., Bohn. Ed., II., 20.
[3] Kunth. Syn., 1823, II., 157.
[4] Dunal. Solan., 110.
[5] Salisbury. Trans. N. Y. Ag. Soc., 1848, 371.

ranked racemes, which are frequently quite large and abundantly filled. It grows wild in Peru and Brazil, and is figured by Feuille[6] in 1725, but not as a cultivated plant, and is described by Linnæus[7] in 1763. The grape or cluster tomato is recorded in American gardens by Burr[8] in 1863, and as the red currant tomato by Vilmorin[9] in 1883 and 1885. It is an exceedingly vigorous and hardy variety, with delicate foliage, and fruits most abundantly. The berries make excellent pickles.

According to the test of cross-fertilization, few, if any, of the above are true species. Two only of the above named—the cherry and the currant tomato—do I find recorded in a truly wild condition. The tomato has, however, been under cultivation from a remote period by the Nahua and other Central American nations, and reached European and American culture, as all the evidence implies, in an improved condition. If there is any evidence that any of our so-called types arose spontaneously from the influences of culture, I have failed to note it. We may well ask, Why did not other forms appear during the interval from 1558 to 1623, when but one sort, and that figured as little able,vari received the notice of the early botanists?

The modern names of the *tomato*, or *love apple*, are in France, *tomate*, *pomme d'amour*, *pomme d'or*, *pomme du Perou*; in Germany, *tomate*, *liebesapfel*; in Flanders and Holland, *tomaat*; in Italy, *pomo d'oro*; in Spain and Portugal, *tomate*; in Norway, *kjoerlighedsaeble*.[10]

In Arabic, *bydingan toumaten*;[11] in Burma, *kha-yan-myae-phung*;[12] in Ceylon, *maha-rata-tamattie*;[13] in the Deccan, *wall-wangee*; in Egypt, *bydingan toumaten*; in Malaya, *tomatte*; in Tagalo, *tomates*, *camatis*;[12] in Tamil, *seemie-takalie-pullam*;[13]

[6] Feuille. Per., 1725, 37, t. 25.
[7] Linnæus. Sp., 1763, 265.
[8] Burr. Field and Gard. Veg., 1863, 646.
[9] Vilmorin. Les Pl. Pot., 554.
[10] Schubeler. Culturpf., 91.
[11] Delile. Fl. Æg. Ill.
[12] Pickering. Ch. Hist., 615.
[13] Birdwood. Veg. Prod. of Bomb., 173.

in Indian gardens, *goot-begoon, oou laeetee buengun* ;[14] in Mexico, *jomatl* ;[15] in Japan, *akanasu*, red egg-plant.[16]

TURNIP. *Brassica* sp.

Vilmorin in his "Les Plantes Potageres," 1883, classes all the *turnips* under *Brassica napus* L.; but the older authors referred them, more correctly as we think, to *Brassica napus* and *B. rapa*. Decandolle,[17] who makes this distinction, separates the first into three groups, based on color, the white, yellow, and black; the second into groups, comprising the white, yellow, black, red, and green. In the thirteenth century Albertus Magnus describes the *napus* as with a long root, which is eaten, and the *rapa* as having a spherical compressed bulb, and sometimes red in the stalk. The turnip is of ancient culture. Columella,[18] A. D. 42, says the *napus* and the *rapa* are both grown, and the latter the larger and greener for the use of man and beasts, especially in France; the former not having a swollen, but a slender, root. He also speaks of the *Mursian gongylis*, which may be the round turnip, as being especially fine. The distinction between the *napus* and the *rapa* was not always held, as Pliny[19] uses the word *napus* generically, and says that there are five kinds, the Corinthean, Cleonæum, Liothasium, Bœoticum, and the Green. The Corinthean, the largest, with an almost bare root, grows on the surface, and not, as do the rest, under the soil. The Liothasium, also called Thracium, is the hardiest. The Bœoticum is sweet, of a notable roundness, and not very long as is the Cleonæum. At Rome the Amiternian is in most esteem, next the Nursinian, and third our own kind (the green?). In another place, under *rapa* he mentions two kinds, the one broad-bottomed (flat?), the other globular, and the most esteemed those of Nursia. The *napus* of Amiterninum, of a nature quite similar to the *rapa*, succeeds best in a cool place. He mentions that the *rapa* sometimes attain a weight of

[14] Speede. Ind. Handb. of Gard., 176.
[15] Heller. U. S. Pat. Of. Rept., 1874, 411.
[16] K. Tamari.
[17] Decandolle. Mem., 1821, 26, 30.
[18] Columella. Lib., II., c. 10, etc.; X., c. 421.
[19] Pliny. Lib., XIX., c. 25; Lib., XVIII., c. 34, 35.

forty pounds. This weight has, however, been exceeded in modern times. Matthiolus,[20] in 1558, had heard of turnips that weighed a hundred pounds, and speaks of having seen long and purple sorts that weighed thirty pounds. Amatus Lusitanus,[21] in 1524, speaks of turnips weighing fifty and sixty pounds. In England, in 1792, Martyn[22] says the greatest weight that he is acquainted with is thirty-six pounds. In California, about 1850, a turnip is recorded of one hundred pounds weight.[23]

Brassica napus esculenta DC.[17]

This differs from the *Brassica rapa oblonga* by its smooth and glaucous leaves. It surpasses other turnips by the sweetness of its flavor, and furnishes white, yellow, and black varieties. It is known as the Navet or French turnip.[17] It was apparently the *napa* of Columella.[18] It was certainly known to the early botanists, yet its synonymy is difficult to be traced from the figures. I think, however, the following are correct:

Napus. Trag., 1552, 730; Matth., 1554, 240; Pin., 1561, 144; Cam. Epit., 1586, 222; Dod., 1616, 674; Fischer, 1646.

Bunias sive napus. Lob. ic., 1591, I., 200.

Bunias silvestris lobelii. Ger., 1597, 181.

Napi. Cast. Dur., 1617, 304.

Bunias. Bodæus, 1644, 773.

Napus dulcis. Blackw., 1765, t. 410.

Navet petit de Berlin. Vilm., 1883, 360.

Teltow turnip. Vilm., 1885, 580.

The *navews* are mentioned as under cultivation in England by Worlidge,[24] in 1683, as the *French turnip* by Wheeler,[25] in 1763, and Miller's Dictionary, 1807. Gasparin[26] says the *navet de Berlin*, which often acquires a great size, is much grown in

[20] Matthiolus. Com., 1558, 240.

[21] Amatus Lusitanus. In Diosc., 1554, 247.

[22] Martyn. Fl. Rustica, 1792.

[23] A. Williams. U. S. Pat. Of. Rept., 1851, 4.

[24] Syst. Hort. By J. W. Gent, 1683, 181.

[25] Wheeler. Bot. and Gard. Dict., 1763, 81.

[26] Gasparin. Cours de Agr., IV., 116.

Alsace and in Germany. In China, according to Bretschneider,[27] it was known in the fifth century.

Brassica rapa depressa DC.

This has a large root expanding under the origin of the stem into a thick, round, fleshy tuber, flattened at the top and bottom. It has white, yellow, black, red or purple, and green varieties. It seems to have been known from ancient times, and is described and figured in the earlier botanies.

A. Flattened both above and below.

Rapum. Matth., 1554, 240; Cam. Epit., 1586, 218.
Rapum sive rapa. Pin., 1561, 143.
Rapa. Cast. Dur., 1617, 386.
Navet turnip. Vilm., 1883, 583.

B. Flattened, but pointed below.

Orbiculatum seu turbinatum rapum. Lob. ic., 1791, I., 197.
Rapum. Porta, Phytognom, 1591, 120.
Rapum vulgare. Dod., 1616, 673.
Rave d'Auvergne tardive. Vilm., 1883, 369.

C. Globular.

Rapum. Trag., 1552, 728.
Rapa, La Rave. Tourn., 1719, 113.
Navet jaune d'Hollande. Vilm., 1883, 370.
Yellow Dutch. Vilm., 1885, 588.

Brassica rapa oblonga DC.

This race differs from the preceding in having a long and oblong tuber tapering to the radicle. It seems an ancient form,—perhaps the Cleonæum of Pliny.

Vulgare rapum alterum. Trag., 1532, 729.
Rapum longum. Cam. Epit., 1586, 219.
Rapum tereti, rotunda, oblongaque radici. Lob. ic., 1591, I., 197.
Rapum oblongius. Dod., 1616, 673.
Rapum sativum rotundum and oblongum. J. Bauh., 1651, II., 838.

[27] Bretschneider. Bot. Sin., 78.

Rapa, La Rave. Tourn., 1719, 113.
Navet de Briollay. Vilm., 1883, 372.
Briollay turnip. Vilm., 1885, 591.

This representation by no means embraces all the turnips now known, as it deals with form only, and not with color and habits. In 1828 thirteen kinds were in Thorburn's American seed catalogue, and in 1887 thirty-three kinds. In France, twelve kinds were named by Pirolle in 1824, and by Petit in 1826. In 1887 Vilmorin's wholesale seed-list enumerates thirty-one kinds.

The turnip is believed to have reached England from Holland in 1550,[28] but before this it had reached the New World. In 1540 Cartier[29] sowed turnip seed at the present Montreal, in Canada. In 1609[30] turnips are mentioned in Virginia, as also in 1649;[31] they are mentioned as cultivated in Massachusetts in 1629.[32] In Peru they are said by Acosta,[33] in 1604, to have increased so abundantly as to become a nuisance in the planting of grain.

The *turnip* is called in France, *navet, gros navet, grosse rave, naveau, navet turnips, rabiole, rabioule, rave plate, tornep, turneps, turnip*; in Germany, *herbst-rube, stoppel-rube*; in Flanders and Holland, *raap*; in Denmark, *röe*; in Italy, *navone, rapa*; in Spain and Portugal, *nabo*;[34] in Arabic, *lift*,[35] *luft*; in Bengali, *shalgram*; in Persia, *shalgram*; in Sindh, *gokhru*;[36] in Japan, *busei, aona* (the round form).[37]

[28] Booth. Treas. of Bot.
[29] Cartier. Third Voy., Pinkerton Voy., XII., 667.
[30] A True Decl. of Va., 1610, 13.
[31] A Perfect Desc. of Va., 1649, 4.
[32] Higginson. Mass. Hist. Soc. Col., 1st Ser., I., 118.
[33] Acosta. Hist., 1604, 261.
[34] Vilmorin. Les Pl. Pot., 1883, 357.
[35] Delile. Fl. Æg. Ill.
[36] Birdwood. Veg. Prod. of Bomb., 137.
[37] Thunberg. Jap., 375.

EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

THE fortieth meeting of the American Association for the Advancement of Science was held at Washington, between August 17th and 25th, inclusive. It was a successful and enjoyable occasion, and the membership present exceeded 800. Representatives from almost all parts of the country, including the Pacific coast, were present. The papers read were generally of a high order of merit. A noticeable feature was the large number of new specialists who appeared, especially in the Biological and Geological Sections, an indication of increased activity in these fields, due in the main to the good work which has been going on in our universities. The overflow of entomological papers was large enough to give the Entomological Club plenty to do, and a good many geological papers went over to the Geological Society of America, whose meetings overlapped those of the American Association. The address of the retiring president, Professor George L. Goodale, on the possibilities of the introduction and cultivation of plants, now only known in the wild state, which shall be of utility to man, was of wide interest. The addresses of the vice presidents were as various as usual. That of the president of the Geological Section was technical, while that of the president of the Biological Section was didactic. Professor Prescott made an excellent presiding officer. Excursions were not allowed to interfere with the work of the association, and they were the more enjoyable on that account. The closing meeting, on the evening of the 25th, was an occasion of much hilarity. Not the least important contribution to this feeling was the address of a youth who presented the association with an invitation to hold the meeting of 1893 at Chicago, during the exposition. In well-considered language the association was asked to contribute its mite to one of the vast aggregate of congresses to be held there, and thus take part in the rejuvenation of the human race which it was anticipated would date from that event. Rochester was selected as the place of meeting for 1892.

—THE American Society of Geologists met on August 24th and 25th, during the meeting of the American Association in the

same building (the Columbian University), in Washington. As the 24th was occupied by the association in excursions, the meeting on the 24th was devoted to papers by foreign members who had arrived with the intention of attending the International Congress. These were Steinmann and Rothpletz, of Germany; Harker and Gregory, of England; Schmidt, Krassnow, and Pavlow, of Russia; De Geer, of Sweden; and Stephanescu, of Roumania. Some of these will appear in future numbers of the NATURALIST. The most important papers contributed by American members were those of President T. C. Chamberlin, Mr. R. T. Hill, and Mr. W. J. McGee. The society was the recipient of papers suitable for the International Congress, after it was decided to restrict the work of the latter body to discussion of definite questions only. Professor Stevenson, of New York, presided over the sessions with his usual ability, and Mr. McGee made an admirable secretary.

—THE fifth meeting of the International Congress of Geologists met at Washington from August 26th to September 1st, inclusive The attendance from foreign countries was larger than was anticipated, although not so large as the list published by the reception committee would indicate. The foreign members were distributed as follows: Austria-Hungary, 2; Belgium, 4; Canada, 3; France, 3; Germany, 17; Great Britain, 6; Mexico, 3; Norway, 1; Roumania, 2; Russia, 4; Sweden, 4; Switzerland, 2; total, 51. Several members were accompanied by ladies; Great Britain sent 2; Roumania, 2; and Russia, 1; total, 56. With some names not classified above, the total number present was about 65. The language selected for the conduct of the affairs of the congress was English, although French has been hitherto universally employed. This was due to the fact that the members of the U. S. Geological Survey, who had assumed the management of the congress, could neither speak French nor understand it when spoken.

Professor Newberry, the acting president, was ill, and unable to attend, so that his place was occupied successively by the first vice president, Professor Jos. Le Conte, and Professors Von Zittel of Munich, and Gaudry of Paris. The honorary presidents were Professors J. D. Dana and James Hall. The second and third vice presidents were Maj. J. W. Powell and Mr. Raphael Pumpelly.

The discussions as arranged by the committee of management had reference, 1st, to the general principles of stratigraphic correlation; 2d, to the system of colors for geologic maps; and 3d, to the system of classifications of the Plistocene deposits. The necessity for discussion of the principles of correlation was not very apparent, since those principles are well known and generally adopted. The discussion, however, brought out some consideration of intercontinental and transcontinental applications of these principles, which were entirely appropriate to an international congress. Much of the discussion, however, bore on the question as stated, and was either inappropriate or local in its bearings. The discussion on the classification of the Plistocene was based on two systems, one offered by Mr. McGee and the other by President Chamberlin. Both are physical systems, and not historical, as was observed by various gentlemen who took part in the discussion. They were, however, of universal application, and many interesting facts were brought out, especially with reference to the existence or not of an interglacial warm climate on both hemispheres.

The congress was entertained by receptions at the Arlington Hotel, the U. S. National Museum, and the private houses of Messrs. Thomas Wilson and S. F. Emmons. Nearly all the foreign members took part in the excursion to the Rocky Mountains, Grand Canyon of the Colorado, and Yellowstone Park, which left Washington, September 2d, from which they are expected to return about September 25th. Before the meeting of the congress many of the members visited the paleontological collections at New Haven and Princeton, and during the congress, the collection of Prof. Cope at Philadelphia. Some interesting specimens from New Haven were exhibited in the U. S. National Museum.

The congress was overtaken at its opening by a spell of hot weather, which constituted a drawback to the enjoyment of some of the members. As an educator to the younger American geologists it was a successful occasion. We can point out some material defects of management which would not have occurred had the meeting been held in Philadelphia, as originally intended; but we postpone this for another occasion.

RECENT BOOKS AND PAMPHLETS.

ALLEN, J. A.—On a Collection of Mammals from Southern Texas and Northeastern Mexico. Ext. Bull. Am. Mus. Nat. Hist., Vol. III., No. 2. From the author.

BRAINERD, E.—The Chazy Formation in the Champlain Valley. Bull. Geol. Soc. Am., Vol. II., pp. 293-300. From the society.

CAMPBELL, H. D., and W. G. BROWN.—Composition of Certain Mesozoic Igneous. Rocks of Virginia. Bull. Geol. Soc. Am., Vol. II., pp. 339-348, From the society.

DAVIS, W. M., and WARD LOPER.—Two Belts in the Triassic Formation of Connecticut. Bull. Geol. Soc. Am., Vol. II., pp. 415-430. From the society.

GILL, T.—Note on the Aspredinidæ.—The Characteristics of the Family of Scatophagoid Fishes. Ext. U. S. Nat. Mus., Vol. XIII. From the museum.

HATCH, F. H.—An Introduction to the Study of Petrology: The Igneous Rocks. From Macmillan & Co.

IVES, J. E.—Crustacea from the Northern Coast of Yucatan, the Harbor of Vera Cruz the West Coast of Florida, and the Bermuda Islands. Proc. Phila. Acad. Nat. Science. March, 1891. From the author.

LADD, C. E.—The Clay, Stone, Lime, and Sand Industries of St. Louis City and County. Bull. No. 3, Geol. Surv. Mo. From the author.

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LAWSON, A. C.—Note on the Pre-Paleozoic Surface of the Archean Terranes of Canada.—The Internal Relations and Taxonomy of the Archean of Central Canada. Exts. Bull. Geol. Soc. Am., Vol. I., pp. 163-174, 175-194. From the society.

LECONTE, J.—Tertiary and Pre-Tertiary Changes of the Atlantic and Pacific Coasts, with a Note on the Mutual Relations of Sand-Elevation and Ice-Accumulation During the Quaternary Period. Bull. Geol. Soc. Am., Vol. II., pp. 323-330. From the survey.

LEUTHARDT, F.—Ueber die Reduction der Fingerzahl bei Ungulaten. From the author.

LYDEKKER, R.—On the Generic Identity of Sceparnodon and Phascolonus. Ext. Proc. Roy. Soc., Vol. XLIX.—On Certain Ornithosaurian and Dinosaurian Remains. Ext. *Quart. Jour. Geol. Soc.*, February, 1891.

MILLER, S. A.—A Description of Some Lower Carboniferous Crinoids from Missouri. Bull. No. 4, Geol. Survey of Missouri. From the author.

OSBORN, H. F.—A Review of the Cretaceous Mammalia. Reprint Proc. Acad. Nat. Sci., Phila., January, 1891. From the author.

OSBORN, H.—The Pediculi and Mallophaga Affecting Man and the Lower Animals. Bull. No. 7, U. S. Dept. Agri., Div. Entomol. From the department.

PACKARD, A. S.—Fifth Report of the U. S. Entomological Commission. Forest Insects. From J. M. Rusk, Secretary of Agriculture.

Proceedings Annual Meetings held at New York, December, 1889. Bull. Geol. Soc. Am., Vol. I., pp. 517-593. From the society.

PUMPELLY, R.—The Relation of Secular Rock Disintegration to Certain Transitional Crystalline Schists. Bull. Geol. Soc. Am., Vol. II., pp. 209-224. From the society.

Reports of the American Sub-Committees, International Congress of Geologists, 1888.

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Report of the Board of Managers of the Observatory of Yale University, 1889-'90.

Report Missouri State Geologist to the Thirty-sixth General Assembly.

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RINGUEBERG, E. N. S.—The Crinoidea of the Lower Niagara Limestone at Lockport, N. Y., with New Species. Annals N. Y. Acad. Sci., Vol. V., July, 1890. From the author.

RUSSELL, I. C.—Notes on the Surface Geology of Alaska. Bull. Geol. Soc. Am., Vol. I., pp. 99-162. From the survey.

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SMITH, S. I.—Report on the Decapod Crustacea of the "Albatross" Dredgings off the Eastern Coast of United States. Ext. Annual Report of Com. Fish and Fisheries for 1885. From the author.

SPENCE, T. B.—A Comparison of the External and Middle Ear of Man and the Cat. Proc. Soc. Micros., 1890. From the society.

SPENCER, J. W.—Ancient Shores, Boulder Pavements, and High-Level Gravel Deposits in the Region of the Great Lakes.—The High Continental Elevation During the Plistocene Period. Ext. Bull. Geol. Am., Vol. I., 1889.

——Post-Plistocene Subsidence *versus* Glacial Dams. Bull. Geol. Soc. Am., Vol. II., pp. 465–476. From the society.

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TROUESSART, E.—Extrait de l'Annuaire Geologique Universal. Tome V., Mammifères. From the author.

UPHAM, W.—Glacial Lakes in Canada. Bull. Geol. Soc. Am., Vol. II., pp. 243–276.

——Report of the Exploration of the Glacial Lake Agassiz in Manitoba. Geol. and Nat. Hist. Survey Canada, Part E, Vol. IV., 1888–'89.

——The Floods and Great Lake Basins of North America Considered as Evidence of Pre-Glacial Continental Elevation, and of Depression During the Glacial Period. Bull. Geol. Soc. Am., Vol. I. From the society.—Artesian Wells in North and South Dakota. *Am. Geol.*, October, 1890. From the author.

VOSSION, S.—Khartoum et le Soudan d'Egypte. From the author.

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WEED, W. H.—The Cinnabar and Bozeman Coal Fields of Montana. Bull. Geol. Soc. Am., Vol. II., pp. 349–364. From the survey.

WHITE, C. A.—On the Biological and Geological Significance of Closely Similar Fossil Forms. Proc. Am. Ass. Adv. Science, Vol. XXXIX. From the author.

WHITMAN, C. O.—Some New Facts about Hirudinidæ. Reprint from *Jour. Morph.*, Vol. II., April, 1889. From the author.

WILDER, B. G.—Macroscopic Vocabulary of the Brain, with Synonyms and References.—List of Scientific Publications.—Excerpt from the Trans. Am. Neur. Ass —Reprint *Jour. Nerves and Mental Diseases*, November, 1890.—On the Lack of the Distance Sense with the Prairie Dog (*Cynomys ludovicianus*). From the author.

WINCHELL, A.—A Last Word with the Huronians. Bull. Geol. Soc. Am., Vol. II., pp. 85–124. From the author.

WOOD-MASON J.—A Catalogue of the Manatodea. From the trustees of the Indian Museum.

WOODWARD, A. E.—The Mineral Waters of Henry, St. Clair, Johnson, and Benton Counties. Bull. No. 3, Missouri Geol. Surv. From the survey.

WOODWARD, A. S.—On Atherstonia, a New Genus of Paleoniscid Fishes from the Karoo Formation; and on a Tooth of Ceratodus from the Stormberg Beds of the Orange Free State.—On the Myriacanthidæ, an Extinct Family of Chimæroid Fishes.—Acanthodian Fishes from the Devonian of Canada.—On the So-Called Cretaceous Lizard Raphiosaurus. Ext. *Ann. and Mag. Nat. Hist.*, 1889.—The Fossil Fishes of the Hawksbury Series at Gosford. Ext. Mem. Geol. Surv., New South Wales, Paleont. No. 4.—On the Occurrence of the Devonian Ganoid Onychodus in Spitzenbergen.—Paleontology in the Malton Museum.—Note on *Rhinobatus bugesiacus*, a Selachian Fish from the Lithographic Stone.—Preliminary Notes on Some New and Little-Known British Jurassic Fishes. Ext. *Geol. Mag.*, Decade 3, Vol. VI., 1889. From the author.

WOODWARD, A. S., and C. D. SHERBORN.—Catalogue of British Fossil Vertebrata. Ext. *Geol. Mag.*, January, 1891. From the authors.

RECENT LITERATURE.

Morris's Aryan Race.[1]—This work opens with a general description of the races of mankind, and then proceeds to discuss the origin of the Aryans, their migrations, and their history in general. The author adopts the view of Latham and others, that their original home was Southeastern Russia, and not the highlands of Western Asia. He summarizes the evidence, which is largely derived from the Sanscrit language. That the original home of the Aryans was not Southwestern Asia is indicated by the fact that that language contains no names for the lion and tiger ; that it was not from Northwestern Asia is shown by the absence of a name for the camel. The supposition that Scandinavia was the land is shown to be incorrect by the fact that there is no word for the reindeer, and because the Aryans were a pastoral people, and not dwellers in forests.

His discussion of the ethnic origin of the Aryans is of course speculative. He supposes that the dark-colored tribes which now inhabit the more southern latitudes from India to Spain were derived by descent from the negro race, while the northern light-colored types were derived from the Mongolian. The derivation of the Aryans from the Mongolians at a remote and prehistoric period is among the possibilities, but that the darker forms have a negro origin is scarcely so. The origin of both must be traced to prehistoric—say neolithic—man, and it may be that the light (Xanthochroic) Aryans really represent the race in its pure form, and that the darker races (Melanochroi) represent either the primitive neolithic race, or are the product of hybridization between it and the Xanthochroi.

Mr. Morris describes briefly the western migrations of the light tribes, the Celts, Teutons, and Slavonians ; and those of the darker Pelasgi, Hellenes, etc. ; and later treats of the eastern extension to Persia and India, which established the Iranian and Hindoo populations. These supposed migrations are illustrated by the descriptions of the Gauls and Teutons left us by the Roman authors.

The chapters on the religious, philosophical, and poetic achievements of the Aryans will instruct the general reader, and the concise definitions of the intellectual and moral merits of the race form a scientific index of the line of human progress. The last chapter contains a brilliant forecast of the increasing greatness and power of this the latest and the best product of human evolution.

[1] The Aryan Race : Its Origin and Its Achievements. By Charles Morris. S. S. Griggs & Co., Chicago, 1888, pp. 8vo. 350.

The work is necessarily, from its brevity, synoptic in its treatment of the subject, and as such is especially adapted to instruct persons engaged in active life, whose time for reading is limited. To such persons we can recommend the work, as expressing in a brief space the results of recent research in a field of the greatest interest to all students of mankind or of our own part of it.—E. D. COPE.

Boulenger on Rhynchocephalia, Testudinata, and Crocodilia.[2]—In this book of 300 pages we have another valuable result of the labors of Dr. Boulenger, which will be of great utility to the students of the Reptilian orders named. The very full collections at the disposal of the author enable him to settle many questions of specific characters that have awaited elucidation, and to assign to their proper places in the system many forms which have been named. The system adopted is clear, and expresses the present state of our knowledge. For many of its good points the author is indebted to Dr. George Baur, whose recent researches in this field have been of great value. Dr. Boulenger has used Dr. Baur's observations with judgment, attaching values to them in accordance with their merits. We think he has undervalued the character of the mutual attachment of the plastron and carapace. On the other hand, the peculiarity of the nuchal bones has enabled Baur to distinguish the Dermatemydidæ from the Emydidæ. We do not now give as high a rank to the Athecæ as does Boulenger, nor would we abolish the suborders, as is proposed by Baur, but have adopted an intermediate course.

Dr. Boulenger reaches a remarkable conclusion as to the relations of the Trionychidæ with broad alveolar surfaces for crushing, to those with acute edges of the jaws. He finds that species of India, China, and Africa present individuals with both kinds of structure, which are otherwise undistinguishable, except by a few correlated characters. He thinks that the facts indicate a dimorphism in such species, one form being piscivorous and the other conchivorous. He has not found any young individuals with broad grinding alveolar surfaces, and suspects that that modification is acquired by the animal's entering on a diet of Mollusca, and that it is maintained by persistence in it throughout life. The genus Platypeltis thus becomes a modification of Trionyx. This is certainly a remarkable proposition, and it ought not to be difficult to prove or disprove it by observations on our *Trionyx ferox*, the only North American species supposed to present constantly broad and flat alveolar surfaces.

[2] Catalogue of the Chelonians, Rhynchocephalians, and Emydosaurians in the British Museum By G. A. Boulenger. Published by the trustees, 1889.

The whole number of Testudinata recorded by Dr. Boulenger is 195. Perhaps there are a dozen species omitted. Of the Crocodilia 23 species are recognized.—E. D. Cope.

Frazer's Mineralogical Tables.[3]—The object of Dr. Frazer's tables is to enable the students to determine the nature of the most important minerals without recourse to blowpipe analysis. As is well known, the first edition was a translation of Dr. Weisbach's "Tabellen." In the third edition but little of Weisbach's original descriptions remain. Except the plan, the entire contents of the little book are Dr. Frazer's, so that the volume as it now stands is essentially a new production, in which are incorporated many of the most important portions of Groth's chemical tables and Weisbach's latest determinative tables. The arrangement of the tables is briefly as follows: The minerals are divided in accordance with luster and streak. These groups are printed together, and in columns opposite the names of the various members of each group are given their hardness, tenacity, crystal system and habit, cleavage, chemical composition, density, paragenesis, and a few blowpipe reactions in rare cases. With its aid there should be almost no trouble in deciding the name of any common mineral. The tables are especially valuable for field determinations. They are bound flexible cloth, and are of a convenient size for carrying in the pocket.—W. L. B.

[3] Tables for the Determination of Minerals. By Persifor Frazer. Third edition. Philadelphia, J. B. Lippincott Company, 1891, pp. IX., 115.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Geological Survey of New Jersey, 1890.[1]—This annual report covers the work done under the direction of Mr. I. S. Upson, assistant-in-charge under the late Dr. G. H. Cook, and the present state geologist, Mr. J. C. Smock. It includes the report of Frank L. Nason on the crystalline rocks of the Highlands, and of the magnetic ores of that district; Mr. Coman's notes on (1) the sediments overlying the upper marl beds in eastern Monmouth county, (2) evidences of former shore-lines above the present sea-level, (3) the gravel of the Trenton terrace; Mr. C. C. Vermeule's report on the observations of stream-flow and rainfall up to date; a paper from Mr. Lewis Woolman describing the artesian wells in the southeastern coast-belts of the state; and, finally, an account by G. W. Howell of the drainage work inaugurated by the survey and carried on with so much success and such beneficial results.

Mr. Nason's careful examination of the outcrops has resulted in the discovery of organic remains in the crystalline limestones, which have been referred by Prof. C. E. Beecher to the Cambrian, and below the Potsdam sandstone formation, as has been done by Mr. Lewis Woolman in Pennsylvania. His ideas concerning the limestones of Sussex county are summed up in the following conclusions:

"First, the white limestones of Sussex and Warren counties are of post-Archean age. Second, the white and blue limestones belong to a synchronous horizon. Third, this horizon is the horizon of the Olenellus fauna."

The extent of these conclusions is more far-reaching than is at first sight apparent. First, it demands that a careful search be made for fossils in the whole belt, or rather belts, of limestones, sandstones, slates and shales hitherto called and regarded as Potsdam, Trenton, and Hudson River. The result may prove the existence of a great horizon of rocks in New Jersey, New York, and Pennsylvania hitherto unsuspected, and may also throw much light on the question as to the position of the Green Pond Mountain rocks. Second, in this belt are rocks—limestones, sandstones, slates, iron and zinc ores—in every

[1] Geological Survey of New Jersey: Annual Report of the State Geologist for the year 1890.

degree of metamorphism. The belt is penetrated by various kinds of igneous rocks; and the petrography and chemistry of rocks and minerals in every stage of metamorphism, induced by pressure and heat, can be traced out and its history deciphered to its minutest details. It is rare to find rocks of known geological age in which such favorable conditions exist. The histories thus elaborated can be used most advantageously in deciphering other localities whose history is written in less legible characters.

Elevated Sea-Beach on Grand Cayman.—Southeast from the Isle of Pines, and distant about two and one-half degrees, lies the Grand Cayman Island. Politically it is a dependency of Jamaica, from which it is separated about as far as it is from the Isle of Pines. Geographically it seems to be more closely associated with Cuba than with Jamaica, in so far as any argument derived from the ocean depths around would indicate. The water gradually deepens from about three hundred and fifty fathoms at Cape Cruz (Cuba) to about eight hundred at Cayman Brac and Little Cayman; thence to over one thousand one hundred fathoms as one approaches the Grand Cayman. The course from Cape Cruz to the Grand Cayman is west by south. The distance is one hundred and forty nautical miles; and as the smaller islands of Cayman Brac and Little Cayman lie almost in the line indicated between Cape Cruz and Grand Cayman, and as the water deepens north and south of the line, one readily recognizes the presence of a submarine ridge stretching from Cuba to Grand Cayman, of which these Caymans are themselves merely coral-capped summits.

The main fact here indicated is the distance, and the depth of ocean which surrounds this island of the Grand Cayman; to the south of it two, and even three, thousand fathoms are found. During the past winter I made a brief visit to the southern shore of the Grand Cayman. My attention was called to a sea-beach or wall, fifteen feet above the present tide-level. The most casual observer could not fail to notice that it indicated the action of the water, and that the materials of the beach came from the water. The broken and worn masses of coral along this higher shore led to but one conclusion. I immediately began speculating on the time required to form that shore-line, and how long it took place, etc. The fact is, however, that the whole thing happened in a single day, during one of the fearful hurricanes which swept over the island in the earlier part of this century. The testimony on this point is quite too direct and positive to admit of any doubt.

PLATE XVIII.

Storm Beach on Grand Cayman.

The vast depth of water to the south of the island, and the long unbroken sweep of the ocean in the same direction, prepare one to believe anything might be possible when that vast body of water was urged on by a tropical hurricane. The illustration shows the hurricane beach above and the present line of the water below. (Plate XVIII.)

The most obvious lesson of this special case is a due caution in reasoning on shore elevations, unless all the elements of the problem are absolutely known.—J. T. ROTHROCK.

New Acquisitions to the Eocene Fauna from Southern Patagonia.—In a letter dated May 5th, 1891, M. Florentino Ameghino informs us of the paleontological researches of his brother, Carlos Ameghino, on the borders of the river Gallegos, in Patagonia,—whose former researches we have already made known to our readers. The new results may be summed up as follows:

1. The lemurs (Prosimiæ) are for the first time found in the Eocene of Patagonia.

2. The discovery of new species of Microbiotheriidæ in good condition serves to confirm the opinion advanced by M. Ameghino in his last work on the Plagiaulacidæ. The Microbiotheriidæ have multiple incisors (four on each side), and so seem to represent the ancestral type of the Plagiaulacidæ and of the Diprotodont Marsupials.

3. The same formation furnished an entirely new group of Plagiaulacidæ with multitubercular molar teeth, but with the same dental formula as the species already known. The last molar is, however, entirely rudimentary. These new types connect the Plagiaulacidæ of Patagonia previously described with the Plagiaulacidæ of Europe and of North America. (*Revue Scientifique*, July 4th, 1891.)

The Progress in Geology for the Years 1887–1888.—In a résumé of the geological work done in the years 1887–1888, Mr. W. J. McGee cites the following as the most important:

1. The transition from an empiric classification in geology to a natural one by processes or by fundamental principles and laws.

2. The birth of the new geology, which interprets geologic history from the records of degradation, as the old geology did from the records of deposition.

3. The invention of a method of determining the depth of earthquake centers and of the velocity of earthquake transmission.

4. The recognition and definition of a great geologic group,—the Algonkian, and also of a subgroup of rocks,—the Lower Cretaceous, and the correct determination of the succession of the subordinate

divisions of the Silurian and Cambrian in the structurally complex field east of the Hudson River. (Smithsonian Report for 1888.)

We fail to see that Mr. McGee sustains the comprehensive claims made under the first and second heads. Both departments of geology referred to had been fully established prior to 1887 !

Fossil Birds from the Equus Beds of Oregon.—In the AMERICAN NATURALIST of last April (1891) the present writer invited attention to the fact that he had in hand for description a large collection of fossil birds from the Upper Pliocene of the Silver Lake region, Oregon. A small part of these had been loaned by Professor Condon, of the University of Oregon, but the great bulk of the collection belonged to the cabinet of Professor Cope, who had with marked generosity placed them at my disposal for the aforesaid purpose.

My labors upon this fine collection have now been completed, and the work is ready to be passed into the hands of the printers and engravers. The memoir will make a quarto volume of upwards of a hundred pages, and is illustrated by four quarto plates, presenting over forty figures of the bones of the new species and genera.

The present notice pretends to be nothing more than a brief abstract, giving a list of the species described, with remarks thereon. Those indicated by an * have already been either noticed or described elsewhere by Professor Cope.

PYGOPODES.

1. *Æchmophorus occidentalis.**
2. *Colymbus holbœllii.*
3. *Colymbus auritus ?*
4. *Colymbus nigricollis californicus.**
5. *Podilymbus podiceps.**

LONGIPENNES.

6. *Larus argentatus smithsonianus.*
7. *Larus robustus.* Sp. nov.
8. *Larus californicus ?*
9. *Larus oregonus.* Sp. nov.
10. *Larus philadelphia.*
11. *Xema sabinii.*
12. *Sterna elegans ?*
13. *Sterna fosteri ?*
14. *Hydrochelidon nigra surinamensis.*

STEGANOPODES.

15. *Phalacrocorax macropus.**
16. *Pelecanus erythrorhynchus ?*

ANSERES.

17. *Lophodytes cucullatus.*
18. *Anas boschas.*
19. *Anas americana.*
20. *Anas carolinensis.*
21. *Anas discors.*
22. *Anas cyanoptera ?*

23. *Spatula clypeata.*
24. *Dafila acuta.*
25. *Aix sponsa.*
26. *Aythya marila nearctica ?*
27. *Glaucionetta islandica.*
28. *Clangula hyemalis.*
29. *Branta hypsibatus.**
30. *Branta propinqua.* Sp. nov.*
31. *Branta canadensis.**
32. *Anser condoni.* Sp. nov.
33. *Anser albifrons gambelii.**
34. *Chen hyperborea.*
35. *Olor paloregonus.**

ODONTOGLOSSÆ.

36. *Phœnicopterus copei.* Sp. nov.

HERODIONES.

38. *Ardea paloccidentalis.* Sp. nov.

PALUDICOLÆ.

39. *Fulica americana.**
40. *Fulica minor.* Sp. nov.

LIMICOLÆ.

41. *Phalaropus lobatus.*

GALLINÆ.

42. *Tympanuchus pallidicinctus.*
43. *Pediocœtes phasianellus columbianus.*
44. *Pediocœtes lucasii.* Sp. nov.
45. *Pediocœtes nanus.* Sp. nov.
46. *Palæotetrix gillii.* Gen. et Sp. nov.

ACCIPITRES.

47. *Aquila pliogryps.* Sp. nov.
48. *Aquila sodalis.* Sp. nov.

STRIGES.

49. *Bubo virginianus.*

PASSERES.

50. *Scolecophagus affinis.* Sp. nov.
51. *Corvus annectens.* Sp. nov.

Of the fifty-one species here enumerated ten have already been noticed by Cope, three of which were described as new, and one of which has since proved to be new,—*i. e.*, the brant I have described above as *Branta propinqua.*

Larus robustus is represented by a left coracoid, which is nearly perfect. This bone is shorter and stouter than the corresponding element in *Larus glaucus;* otherwise its characters are almost identically the same. *Larus robustus* was a gull rather smaller than *L. glaucus*, with which it may easily have been closely related.

Another gull was *Larus oregonus*, an extinct species new to science, which was about the size of *Larus delawarensis*, and its existence is based upon two humeri, both from the left side of two different individuals. The characters exhibited on the part of these bones are distinctly different from those of other gulls of this size. *Anser condonii* is a great extinct goose, vastly larger than our present existing Canada goose (*B. canadensis*). Its remains are represented in Professor Cope's collection by a fractured *os furcula* and the parts of two others. These were carefully compared with the furculæ of a number of our wild geese and swans of the genera Chen, Anser, Branta, Dendrocygna, and Olor, and it was found that, upon the whole, the majority of its characters agree best with *Anser albifrons*.

These characters and comparisons are dwelt upon in detail in my forthcoming memoir. I have named this goose after Professor Thomas Condon, of the University of Oregon, the first naturalist who discovered and collected any of the remains of fossil birds in the Silver Lake region of Oregon. A fine series of bones represents the new brant, *Branta propinqua*,—a small goose evidently referred to by Cope as a species that came "near *nigricans*." I propose the above name for this now extinct form.

One of the most interesting discoveries made in the Silver Lake region was the fossil remains of a new species of a now extinct flamingo, which I have called *Phœnicopterus copei*, in honor of Professor E. D. Cope, who discovered it. I found a number of bones belonging to this species in the collection, and a study of them reveals the fact that *P. copei* was a somewhat taller and longer-winged flamingo than *P. ruber*, though at the same time it was probably not quite so stout in the body.

A small heron, to which I have given the name of *Ardea paloccidentalis*, and a new coot, *Fulica minor*, smaller than *Fulica americana*, were, as will be seen in the list given above, also among the novelties. The first-named was a species somewhat larger than *A. candidissima*, and smaller than *A. egretta*, with osteological characters identical with existing herons. Osteologically, too, the two coots agree, the species differing only in size.

It will be observed that the Gallinæ were very well represented in the avifauna of Western Oregon during the later Tertiary times, and among their fossil remains I found three species of them that proved to be new. Both of these were closely related to *Pediocætes phasianellus columbianus*. The larger form, *Pediocætes lucasii*, I have named in honor of my friend, Mr. F. A. Lucas, in recognition of his published labors in

avian osteology, and his past and present museum work, both in paleontology and bird-structure.

P. nanus was smaller than *columbianus*, and decidedly smaller than *P. lucasii*.

Another grouse was *Palæotetrix gillii*, a rare form apparently, and one smaller than a female Centrocercus, but considerably larger than the largest forms of Tympanuchus. It was probably related to several of the existing species, and may have been in the ancestral line of the sage cocks. Its remains exhibit osteological characters that differentiate it generically from our present tetraonine types. I have named it in honor of Dr. Theodore Gill, the eminent ichthyologist and biologist.

Two new eagles were also discovered, but their fossil remains were not abundant. *Aquila pliogryps* I believe to have been a large bird.—somewhat larger than *A. chrysaëtos*, to which it was apparently related. In its proportions it was apparently of a more slender build, however, and may have had habits akin to the falcons, and was at any rate a very formidable bird. *Aquila sodalis* was a considerably smaller eagle than *A. pliogryps*, though not much smaller than *A. chrysaëtos*. None of the lesser Accipitres were discovered.

Among the Passeres, I met in the collection with the remains of an extinct blackbird, which I have called *Scolecophagus affinis*, it being related to Brewer's blackbird, and probably in those Pliocene times resorted in numbers to the vegetal growth of the margins of the lakes. *Corvus annectens* was a raven, smaller in size than any of our present ravens, to which it was very closely related.

It is not my intention here to abstract any part of my "conclusions" in reference to the avifauna of the Equus beds of Oregon, as such remarks can well remain until the appearance of the general work upon the subject.

In closing, it gives me pleasure to tender my sincere thanks to Professor G. Brown Goode, of the National Museum, for the unlimited facilities extended to me in the matter of the loan of the skeletons of existing birds from the museum's collections; also to Mr. Lucas for his kindness in getting them to me after my request in that direction had been granted. That material, added to my own collection of bird skeletons, was ample for all purposes of comparison, for all the necessary existing species were at my command.—*R. W. Shufeldt, M.D., Smithsonian Institution, Washington, D. C.*

Geological News.—General.—Mr. L. J. Clark confirms Flemming's theory that the Island of Toronto is formed of material which came originally from the Scarboro' Heights, and that the mechanical

force which transported the material to its present resting-place was the storm action of waves. (Trans. Can. Inst., March, 1891.)——The most interesting fact developed in the recent surveys of the Pacific coast is that the coast-line of Southern California is more abrupt than that of any part of the Atlantic or other portion of the Pacific. (*Scien. Am.*, July 25th, 1891.)

Archean.—Professors Solas and Cole call attention to the streakiness which characterizes the interlamination of an olivine and coral sand-rock, and note its resemblance to eozonal and serpentinous limestone. (Proceed. Roy. Dublin Soc., 1891, p. 124.)

Paleozoic.—Sir William Dawson has described a new fossil plant, *Lepidodendron murrayanum*, from the Carboniferous rocks of Newfoundland. The specimen shows the character of the old stem, branches, and leaves. (Bull. Geol. Soc. Am., Vol. II., p. 532).——Rev. H. Herzer has found in the Upper Helderberg limestone, near Sandusky, Ohio, a fossil fragment of an Alga, which has been described by Prof. Lesquereux under the name, *Halymenites herzerii*. The specimen is remarkable, and of great value, from the fact that its internal structure is so well preserved that its characters are clearly discernible. One or two specimens only of that kind are recorded by paleobotanists (Proceeds Nat. Mus., Vol. XIII.)——Mr. H. M. Ami has contributed a paper to the *Canadian Record of Science*, April, 1891, in which he says that it is perhaps premature to state the precise geological horizon of the strata at Quebec city, but in his opinion they occupy a position in the Ordovician system higher than the Lewis formation, but lower than the Trenton, and are probably an upward extension of Sir William Logan's "Quebec Group." This would make them about equivalent to the Chazy formation of the New York and Ontario divisions.

Mesozoic.—M. Kilian and M. Leenhardt have decided that from a stratigraphical standpoint the sands of the valley of the Apt, in Southeastern France, are Cretacic, and not Tertiary, as has been thought. (Bull. No. 16, Tome II., de la Carte Geol. de la France.)——Mr. A. J. Jukes-Brown and Rev. W. R. Andrews have ascertained, by means of a well sunk at Dinton, Eng., that there is a well-developed Upper Purbeck series in the vale of Wardour, with a thickness of 70 or 80 feet, and this is succeeded by representatives of the Wealden and Vectian series, which, however, are poorly developed, and taken together are less than 100 feet. (*Geol. Mag.*, July, 1891.)——Mt. Diablo is an isolated peak of the Coast Ranges of California, lying about 27 miles

east by north of San Francisco. H. W. Turner reports that it consists of a central mass of metamorphic rocks. The strata immediately surrounding the metamorphic mass are, except for a space on the southwest, of Cretaceous age. Next to the Cretaceous, going away from the mountain in any direction, are Eocene (Tejon) strata, and these are followed successively by Miocene, Pliocene, and Plistocene deposits. (Bull. Geol. Soc. Am., Vol. II., pp. 385–414.)

Cenozoic.—M. Depéret has recently published a list of the fauna from the different Pliocene beds of Theziers. It contains 302 species, and many varieties, of invertebrates, comprising 112 Gastropods, 107 Lamellibranchs, 3 Pteropods, 5 Brachiopods, 3 Crustaceans, 4 Echinoderms, 7 Polyps, and 1 Bryozoan. This is much the most extensive that has been given for any single formation of the valley of the Rhone. (Bull. No. 6, Tome II., de la Carte Geol. de la France.)——M. Gaudry announces the discovery of mastodon remains near Chérichira, in Tunis, probably the jaw of *M. angustidens*, similar to that of the Middle Miocene of Sansan. (*Rev. Sci.*, Ju 20th, 1891.)——In a recent paper (Bull. Wash. Philos. Soc., Vol. XI., pp. 385–410.) on the Mohawk beds in Eastern California, Mr. Henry Ward reaches the following conclusions: "The Mohawk valley is the bed of a Plistocene lake caused by the damming up of the cañon of the Feather River by a flow of andesitic lava. Glaciers existed contemporaneously with the lake."——According to R. Ellsworth Call, the Loess of Eastern Arkansas is Plistocene; the gravels and sands, Tertiary; and the lower clays, as indicated by the few fossils found, are Eocene Tertiary. The Loess about Helena is rich in fossil land-shells, but in general the fossiliferous exposures are few. Minerals of economic importance are not to be found, nor are the lignites of any importance from an economic standpoint. (Ann. Rept. Ark. Geol. Sur., 1889.) ——Recent researches by W. J. McGee have shown that the Appomattox formation consists of a series of obscurely stratified loams, clays, and orange sands, with local accumulations of gravel about waterways. It forms a widespread terrane, almost continuous with the Costal Plain between the Rappahannock and the Mississippi. No characteristic fossils have been found in it, but its stratigraphic position, unconformably below the Plistocene, and uncomformably above the Miocene, indicates an age corresponding roughly with the Pliocene. (Bull. Geol. Soc. Am., Vol. I.)

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—In an argumentative article on the individuality of rocks Lang[2] proposes to regard as a rock individual the product of a continuous (uninterrupted) rock-forming process. Accordingly he would class interbedded clays, sandstones, and conglomerates deposited from the same body of water by a gradual lessening of its velocity, as a single rock, with clayey, sandy, and conglomeratic facies. In the eruptive group, that is a rock individual which has been forced from the depths of the earth by a single earth-throe. The beginning and end of a rock-forming process thus marks the limitations of a rock individual, even though a second period of similar processes should subsequently give rise to a rock of the same nature as that previously formed. The ideas discussed in the article are of great interest, but the practical advantages to be gained by regarding rocks from the point of view of its author are not immediately perceptible.——Another article of some theoretical interest is Justus Roth's criticism of Rosenbusch's[3] recent paper on the chemical nature of eruptive rocks. After giving a short historical review of the attempt to explain the variation in eruptive rocks upon a chemical basis, the author[4] proceeds to examine critically the views set forth by Rosenbusch. In the first place, he states that ten of the sixty-three rocks whose analyses are quoted by this writer are much altered from their original condition; others are but local in distribution, while of others, again, the analyses are incomplete. He further continues by showing that the fundamental magmas by whose mixture the various types of rocks are regarded as made up, far from giving rise to definite varieties when mingled in definite proportions, may themselves consist of different combinations of different minerals. He then calls attention to what appear to be weak points in Rosenbusch's calculations, and concludes with the statement that there is not yet sufficient knowledge concerning the chemical character of eruptives to warrant the construction of a theory concerning their composition.——Loewinson-Lessing[5] has attacked the chemistry of the eruptive rocks in a little different way from Rosenbusch. He compares the relations between the bases and the acid in a rock, and calls

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] *Miner u. Petrog. Mitth.*, XI., p. 467.

[3] AMERICAN NATURALIST, 1890, p. 1071.

[4] *Zeits. d. deuts. geol. Ges.*, 1891, p. 1.

[5] Bull. Soc. Belge de Géol., etc., IV., 1890, p. 1.

those rocks acid that contain an excess of the latter,—*i. e.*, more than enough to saturate the bases present. This excess shows itself as free quartz. Thus it is not the percentage of silica in a rock-mass that carries it into the acid, neutral or basic class, but it is the lack or excess of silica as compared with the bases. Several empirical formulas represent the author's types. They are based on the determined ratio between bases and acid in neutral rocks, in which the amount of silica necessary to saturate the bases (in percentage) is represented by formula $SiO_2 = 2(R_2O + RO) + R_2O_3$. In neutral rocks this relation exists, consequently the formula represents the composition of such rocks. The amount of silica in basic rocks is represented by $SiO_2 = R_2O + RO + R_2O_3$, and in acid rocks $SiO_2 = 2(R_2O + RO) + R_2O_3 + \text{Quartz}$,—*i. e.*, the percentage of silica in these is greater than twice the sum of the percentages of R_2O and RO, plus R_2O_3, by as much as there is quartz in the rock. The author then uses these formulas, with others deduced from them, as a basis for the classication of eruptives. His paper is interesting reading, and if facts justify his formulas the conclusions reached by the author will prove of value to petrographers.——Some recent discussions on the pressure alteration of basic eruptives have added quite a little to our information regarding this phenomenon. Welch [6] has described the alteration of diabases into schists in the region of the Soonwalde, in the Taunus, on the left side of the Rhine. Well-developed diabases exist near Rauenthal. Under the influence of pressure they have given rise to schistose rocks containing actinolite, and others in which chlorite and epodite have replaced the original augite. Other schists, whose relationship to diabase can be determined only by a microscopical examination, have been called hornblende-sericite-schists, augite-schists, and sericite-calc-phyllites. The author has made a careful study of all these, which has resulted in their separation into schists composed of actinolite and epidote, those containing a blue amphibole, and finally those made up principally of chlorite. In some of these derived rocks augite may still be detected, in others the diabase structure is still visible, while in a third class no traces of the original constituents nor of their arrangement are recognizable. All show evidence of pressure in the shapes of their components and in their nature. In the first class the epidote and chlorite have been derived from augite. The second class contains, in addition to glaucophane, a bluish-green actinolite, sericite, and biotite. Epidote is entirely wanting. The rocks of the third group are combinations of chlorite, quartz, sericite, and generally calcite. In each the structure is schis-

[6] *Zeits. d. deuts. geol. Ges.*, XLI., 1890, p. 394.

tose, and the mother-rock was a diabase or a diabase-porphyrite. The paper concludes with a discussion of fifteen analyses of the rocks described.——Dynamically altered diabase and gabbros (sometimes schistose) occur also as sheets and dykes cutting altered sediments at St. Johnstown and Raphoe, in N. W. Ireland. Among them are epidiorites in which, according to Hyland,[7] the hornblende still preserves the ophitic structure of the original augite. The original feldspar was labradorite, but the changes effected in it have yielded a quartz-feldspar-epidote mosaic in which the secondary feldspar is oligoclase.——The schists, granulites, and even some of the massive rocks of the Lizard, England, are distinctly banded. To account for the phenomenon it has been suggested that it is due either to original sedimentation, or to the deformation of eruptive rock-masses, or to the injection of rock material along planes of weakness in preëxisting rocks. Since the schists are now known to be eruptive, the first explanation is not available. Against the second Somervail[8] brings the following objections, viz.: the symmetry of the banded structure, the frequent transitions between adjacent bands, and the uniform banding in large masses of the same composition. The injection theory is contradicted by the absence of irruptive contacts. He accounts for it on the supposition that segregations formed during the cooling of the magmas, yielding "schieren" that were afterwards squeezed.——A green schistose rock from near Zermatt, in the Pennine Alps, occurs so associated with other schists that Bonney[9] is compelled to regard it as a pressure schist derived from serpentine. The rock is so very fissile that it may be split into sheets one-eighth of an inch thick. Only two essential constituents are observed in it, one an olive-green mineral, occurring in small translucent flakes with a cleavage like mica and an extinction parallel to this, and the other a chromite or magnetite. The former mineral may possibly be antigonite. Associated with this rock are two other schists: one, a green schist, is a soft chloritic rock, composed of chlorite, magnetite, and zoisite (?). The composition of the chlorite is probably near that of chloritoid. The other schist is full of talc. The origin of neither of these could be determined.——A suggestion in explanation of the cause of the transitions sometimes seen between crystalline and clastic rocks has recently been offered by Prof. Pumpelly,[10] who believes that rock disintegration by weathering

[7] *Geol. Magazine*, 1890, p. 205.

[8] Ib., Nov., 1890, p. 509.

[9] Ib., Dec., 1890, p. 533.

[10] Bull. Geol. Soc. Amer., Vol. II., p. 209.

has, in many cases, given rise to thick accumulations of loose material, which has subsequently been used in the manufacture of the detrital beds. If the new beds were laid down under the influence of gentle currents their basal member would contain a large proportion of the material of the older rocks, and would thus simulate them to a greater or less extent. If this explanation is found to hold good, it will obviate the supposed necessity of regarding granite and gneiss as derived from fragmental rocks by some form of obscure metamorphism.——Rosenbusch[11] attacks the subject of the origin of the schists from a chemical standpoint. He shows by citing analyses that some foliated rocks have compositions corresponding to those of massive rocks. These he regards as squeezed eruptives. Others are different in composition from any known eruptive. These he regards as dynamically changed sedimentaries. The foundation principle underlying the argument is that dynamo-metamorphism affects but little chemical change in the material upon which it acts, except such as may be brought about by percolating water.

Mineralogical News.—The unique mineral *melanophlogite* has been made the subject of recent study by Friedel[12] and by Streng.[13] The former writer has examined the apparent cubes of the mineral in polarized light, and has found them to consist of six tetragonal pyramids, with their apices turned in and their bases forming the sides of the cubes. When heated the substance blackens and finally becomes opaque. Its density is 2.030–2.052, and the angle between contiguous cubic faces 91° 23′. The cubical cleavage reported by Lacroix does not exist. Some crystals appear to be simple cubes, while others are made up of many individuals, which in their section appear as fibers radiating from a center. They owe their form, consequently, not to pseudomorphism. They are pseudo-regular. A very careful analysis of these crystals yielded a result corresponding to $20SiO_2+SO_3$, with small quantities of $SrSO_4$ and carbon. The crystals are implanted in opal. Other crystals, very similar to those described above, are the pseudomorphs of quartz described by Mallard. They have not the same density as melanophlogite, nor the same optical properties. The formation of the latter mineral is ascribed to the action of SO_3 on quartz. The author also describes fibrous crystals formed by the grouping of hexagonal lamellæ with most of the properties of the

[11] *Miner. u. Petrog. Mitth.*, XII., p. 49.

[12] Bull. Soc. Franc. d. Min., XIII., 1890, p. 356.

[13] Ber. d. Oberhess. Ges. f. Naturw. und Heilk. 1890, p. 114. Ref. *Neues Jahrb. f. Min.*, etc., 1891, I., p. 18.

tetragonal melanophlogite. Analysis of these gave $SiO_2 = 93.2$ per cent., $SO_3 = 5.7$ per cent. This substance loses twelve per cent. of its weight on heating, while the tetragonal mineral loses six per cent. Streng declares that the mineral does not contain sulphuric acid, since it yields SO_3 only when treated with an oxidizing agent. Whether the sulphur is in the form of free sulphur or of an organic sulphide, could not be determined by him. The crystals, according to this author, are bounded by ∞O∞ and ∞O2, and are probably pseudomorphs of opal and quartz after some unknown mineral.——A little more than a year ago the nodular rose-red *eudialite* of Magnet Cove, Arkansas, was described by Hidden and Mackintosh.[14] Recently crystals of the substance have been investigated by Dr. J. F. Williams.[15] These are tabular transparent or translucent rose-colored or crimson bodies traversed by cracks in all directions. They are hexagonal with $a : c = 1 : 2.1174$. OR, ∞P2, R, —½R, —2R appear on one crystal, and on another occur in addition $-\frac{3}{11}$R, ¼R. ⅕R and —¾R[5]. The density varies between 2.804 and 2.833, and the double refraction is positive. It is one of the youngest of the constituents of the eleolite-syenite in which it occurs. The negatively refracting *eucolite*, of about the same composition as eudialite, appears in brownish-yellow crystals in the same rock. In it a cleavage parallel to OR is quite pronounced. OR, R, —½R, ∞R, and ∞P2 bound its crystals. Its specific gravity is 2.6244–2.6630, and its hardness 5–5.5. He thinks it may be an altered eudialite.——The zinc-bearing *rhodonite* from Franklin and Sterling, N. J., has been reinvestigated by Pirsson.[16] The crystals are usually tabular and elongated, parallel to ∞′Ṕ. The new planes $2\bar{P}\infty$, $4\bar{P}\infty$ and 4P′ were observed. The axial ratios, calculated from the best measurements obtained, are: $a : b : c = 1.078 : 1 : .6263$, $\alpha = 103° 39'$, $\beta = 108° 48' 30''$, $\gamma = 81° 55'$. The cleavage is prismatic, and the extinction on the basal plane is 54° from the edge OP∧Ṕ/. Since the crystallographic constants and the extinction of the mineral differ so slightly from those of rhodonite, it seems that the morphotropic action of the zinc is but slight. Composition:

SiO_2	FeO	ZnO	MnO	CaO	MgO
46.06	3.63	7.33	34.28	7.04	1.30

corresponding to $RSiO_3$.——Upon data collected during the course of many analyses of *uraninite* from American and foreign localities, Mr.

[14] *Amer. Jour. Sci.*, XXXVIII., 1889, p. 494.

[15] Ib., Dec., 1890, p. 457.

[16] Ib., XL., Dec., 1890, p. 484.

Hillebrand[17] concludes that nitrogen is a constant constituent of the mineral, and in a form different from any hitherto observed in the mineral kingdom; that its composition varies widely, and with it the physical characteristics; and, finally, that the composition does not correspond with any formula proposed to represent it. The author proposes to continue its study, and asks the aid of mineralogists in securing specimens.——Excellent transparent crystals of *anthophyllite* have been obtained by Mr. Penfield[18] from Franklin, Macon county, N. C. They are prismatic with ∞P and $\infty P\breve{\infty}$, but no terminations. The ratio $a : b$, based in approximate measurements, is .51375 : 1. The cleavage is perfect parallel to the prism and the brachypinacoid, and poor parallel to the macropinacoid, $2V_{na} = 88° 46'$, with the corresponding index of refraction for $\beta = 1.6353$; $a = A$, $b = B$, $c = C$. The double refraction is negative for green and yellow light, and positive for red light. Density = 3.093. The composition is:

SiO_2	FeO	MnO	MgO	CaO	H_2O	Al_2O_3	Loss at 100°
57.98	10.39	.31	28.69	.20	1.67	63	.12

——The so-called *perowskite*[19] from Magnet Cove, Ark., proves upon analysis to contain niobium and tantalum, and, therefore, to belong with dysanalyte, and not with perowskite. Its density is 4.18, and composition:

CaO	MgO	FeO	Fe_2O_3	$(Y.Er.Ta)_2O_3$	$(CeLaDi)_2O_3$	Nb_2O_5	Ta_2O_5	TiO_2	SiO_2
33.22	.74	.23	6.16	5.42	.10	4.38	5.08	44.12	.08

——Some new facts with reference to the *beryls*, *bertrandites*, and *phenacites* from Mt. Antero, Col., are communicated by Penfield.[20] The crystals occur implanted in granite or on the feldspar and quartz of this rock. The beryl probably afforded the beryllium for the other two minerals. It occurs in light-green or blue prismatic crystals, usually simple combinations of P and OP, but occasionally also with 2P2 and $\infty P\frac{3}{2}$ The peculiarity of the crystals is the number of depressions observed on various planes. These are pits bounded by pyramidal faces, and into them long needles of beryl project. The forms on the needles are $12P\frac{6}{5}$, 1.2P2 and 2P. The axial ratio of the *bertrandite* is .5993, instead of .5953, as printed in the author's first paper[21] on the mineral. Some of the crystals of phenacite are inter-

[17] Ib., Nov., 1890, p. 384.

[18] Ib., Nov., 1890, p. 394.

[19] Ib., Nov., 1890, p. 403.

[20] Ib., 1890, p. 488.

[21] Ib., XXXVI., 1888, p. 52.

penetration twins, with the base the twinning plane.——*Harmotome* is announced by Ferrier[22] as occurring in calcite filling vuggs in veins cutting the Animikie slates in the vicinity of Rabbit Mountain, Ontario. Besides calcite, the minerals associated with the harmotome are amethyst, fluorite, and pyrite.——Black tin-bearing *rutile* crystals, supposed to be from the Harney Peak district, in the Black Hills, have a density of 5.294. Its composition, according to Headdn eand Pirsson,[23] is $TiO_2 = 90.79$; $FeO = 8.01$; $SnO_2 = 1.35$. The habit is orthorhombic, with P∞, ∞P∞ and P, twinned parallel to 11P∞.——Tin ore has not yet been found in workable deposits in Texas. Most of the material from that state reported as being cassiterite is keilhanite,[24] tourmaline, or black garnet.——Analyses of rhodochrosite from Franklin Furnace, N. J., yielded Browning,[25] after correcting impurities, the following figures:

MnO	CaO	ZnO	MgO	FeO	Fe_2O_3	CO_2	Sp. Gr.
45.55	11.41	1.48	1.78	.22	.16	39.40	3.47

Miscellaneous.—It is a pleasure to know that Messrs. Clarke and Schneider[26] are busy with experiments looking toward the settlement of problems relating to the constitution of natural silicates. The methods employed by them resemble somewhat those that have afforded such excellent results in organic chemistry. Silicates are exposed to the action of hydrochloric acid gas at high temperatures, and to its solution at ordinary temperatures, and the effects in each case are noted. They are then ignited and subjected to other reagents, and the products here obtained are compared with the results of the former experiments. In this way the presence of groups of elements is recognized that are analogous to the residues of carbon chemistry. The conclusion already arrived at by the authors are to the effect of *talc* is an acid metasilicate ($Mg_3H_2(SiO_3)_4$), and not a basic salt of pyrosilicic acid ($Mg(Si_2O_5)_2(MgOH)_2$) as Groth suggests. *Serpentine* is thought be a substituted orthosilicate corresponding to $Mg_2(SiO_4)_2H_3(MgOH)$, and its relation to olivine and chondrodite are represented as follows: Olivine $= Mg_4(SiO_4)_2$; chondrodite $= Mg_3(MgF)(SiO_4)_2$; serpentine $= Mg_2(MgOH)H_3(SiO_4)_2$. *Chlorite* is regarded as $R''_2(SiO_4)_2R'_4$, or olivine with half the magnesiem replaced by R′, and the fluoriferous

[22] Ib., Feb., 1891, p. 161.

[23] Ib., March, 1891, p. 249.

[24] Ib., March, 1891, p. 251.

[25] Ib., Nov., 1890, p. 375.

[26] Ib., 1890, XL., p. 312, 405.

phlogopite from Burgess, Ont., as $Al(SiO_4)_3Mg_3KH_2+Al_2(SiO_4)_3Mg_2K(MgF)$.——Belowsky[27] finds that green hornblende, when subjected for some time to the heat of a bunsen burner, changes its color, the character of its pleochroism, the strength of its double refraction, and the position of its planes of extinction, and becomes in all respects similar to the basaltic variety. Upon the addition of a little sodium chloride[28] to a solution of sodium sulphate, the latter salt crystallizes upon evaporation as *thenardite*, and not as mirabilite. A mixture of potassium and sodium sulphate under the same conditions yield *glaserite*.——A few illustrations of regular growth of pyrite crystals are given by Smolar.[29] Some of the crystals (all of which are from Piedmont and Elba) are probably interpenetration twins according to some new law, while others are regular growth only. The author believes that our knowledge of twinned crystals is still in its infancy, and advises many more observations on regular intergrowths before we conclude as to the conditions of twinning. Rhombic pyramids of sulphur[30] crystallize from picoline or pyridine saturated with sulphuretted hydrogen.——The *oölitic iron ores* of the Cliniton group in the Alleghenies are not cemented concretions, as was supposed, but they are pseudomorphs of bryozoons, or of fragments of these.[31]

ZOOLOGY.

Sipunculus gouldii.—Dr. E. A. Andrews, in a paper[1] that should have received earlier notice, describes the structure of this common east coast Sipunculid. The principal points brought out are the rich peripheral nervous system ; the presence of "pseudostomata" in the splanchnic epithelium, the function of which remains unsettled ; the division of the alimentary tract into several regions, differentiated by anatomical and histological peculiarities; the probability that the stomach is a sucking organ ; the confirmation of the discovery that the reproductive organs were on the posterior surface of the origin of the posterior retractor muscles. Andrews thinks that the points which he has

[27] *Neues Jahrb. f. Min.*, etc., 1891, I., p. 291.
[28] Retgers. Ib., 1891, I., p. 276.
[29] *Zeits. f. Kryst.*, XVIII., 1890, p. 475.
[30] Ahrens. *Ber. d. deutsch. chem. Ges.* XXIII., 1890, p. 2708.
[31] *Amer. Journ. Sci.*, Jan., 1891, p. 28.
[1] Studies Biol. Lab. Johns Hopkins Univ., IV., p. 389, 1890.

brought out emphasize the similarities which exist between the Sipunculids and Phoronis. He also thinks that in spite of the absence of metamerism there is nothing in the anatomy of the adult which could not be explained on the theory of lost segmentation in these worms, while he institutes a striking comparison between the gonads of the Polychæte placed on the posterior side of a dissepiment and those of Sipunculus attached to the posterior surface of the pharyngeal retractors.

Sipunculus nudus.—H. B. Ward describes[2] the anatomy and histology of this Mediterranean form. The material at command embraced only the anterior portions of the body, so no study was made of many features worked out by Andrews. The histology of the body-wall and of the nervous system receive most attention. Among the many points brought out, the most interesting is the existence of a "cerebral organ," consisting of a canal opening to the exterior in the dorsal median line, and connecting posteriorly with an area in close connection with the brain, which the author is inclined to regard as sensory, and to homologize with similarly situated organs in Phymosoma and *Sipunculus gouldii*. The general accounts of structure given by Andrews and Ward agree well in broader features, but differ considerably in detail. From the evidence afforded by the nervous system Ward is inclined to the view that there is only a remote relationship between Sipunculus and the Annelids.

The Eye in Blind Crayfishes.—G. H. Parker has studied[3] the eyes in *Cambarus setosus* and *C. pellucidus*. In both species the optic ganglion and optic nerve are present, the latter terminating in the hypodermis. In *C. setosus* the retina has almost completely degenerated, while in *C. pellucidus* it is represented by a thicker portion of the hypodermis with scattered multinuclear granulated bodies. These Parker regards as degenerated clusters of cone cells. Thus *Cambarus setosus* from the caves of Missouri has gone farther in the line of ophthalmic degeneration than its ally from the caves of Kentucky and Indiana.

"**The Compound Eye of Crustaceans**" is the title of a larger paper[4] by the same author. He gathers together all that is known, adding much himself in the endeavor to solve certain problems surrounding these organs. The retina of the compound eye is composed of a number of similar units or ommatidia, but the structure of the ommatidium varies considerably in different groups. One question

[2] Bull. Mus. Comp. Zool., XXI., No. 3, 1891.
[3] Ib., XX., No. 5, 1890.
[4] Ib., XXI., No. 2, 1891.

which Parker asks is: "What are the means by which ommatidial types are modified, and what is the significance of the changes through which these types pass?" The argument of the present paper is that the ommatidia composed of four cells are more primitive than those containing many cells, and to show how cell-division can have caused the modifications and what other factors may be concerned.

Parker recognizes three types of compound eye so far as retinal structure is concerned: I., represented by Decapods, Schizopods, Stomatopods, Isopods, Leptostra, and Branchiopodidæ of the Phyllopods, has the retina a simple thickening in the superficial ectoderm; II., in Apodidæ, Estheridæ, and Cladocera, the retina does not retain a superficial position, but becomes covered by a fold of the integrement, the pocket remaining open in some and closed in others; III., in Amphipods, and possibly Copepods, the retina is completely separated from the hypodermis, not by an infolding, as in the second type, but by delamination. Of this the author is not certain from actual observation, but he gives a number of facts which warrant his conclusion. Types II. and III. pass through a stage comparable to type I., and hence may be regarded as derivatives from it.

Detailed descriptions of the structure of the ommatidia in various forms are given and illustrated by numerous figures. Continuing his work with that of his predecessors Parker tabulates the ommatidia of the different Curstacea in a manner which conveys at a glance the difference between them so far as numbers of cells are concerned. In an ommatidium going from the surface to the optic nerve there are present (1) the cells of the corneal hypodermis which secrete the cornea; (2) the cone cells, varying in number from two to five, one function of which is to form the crystalline cone; (3) the retinular cells, which may be either undifferentiated or divided into two groups, proximal and distal, the total number varying between three and nine; and (4) accessory pigment, cells which are either of ectodermal or mesodermal origin, all of the rest of the eye being clearly ectodermal.

All compound eyes of the Crustacea are thus clearly built upon a common plan, and the variations between them are traced to (1) the differentiation of cells, (2) the suppression of cells, and (3) probably to multiplication of cells by division, although this last has not been demonstrated by observation.

Parker traces the origin of the ommatidium to such structures as are seen in the Chætopod Nais, where there is an eye composed of a few large transparent cells, the distal portions of which are in part covered

by pigment cells. The transparent cells are the forerunners of the cone cells, while the pigment cells represent an as yet undifferentiated retinular region. This view is clearly opposed to that of Watasi, already noticed in our pages, by which each ommatidium is regarded as an involution of ectodermal cells, the members of which may still retain their power of secreting cuticular structures. The ommatidium, on the contrary, is a differentiated cluster of cells in a continuous unfolded epithelium. Patten's view that the ommatidium is a hair-bearing sense-bud receives no confirmation in Parker's studies.

Eyes in Arcturus.—Beddard describes[5] the eyes in deep and shallow-water species of Arcturus. He finds that some at least of the deep-sea forms show evidences of degeneration in the visual apparatus. Thus in three species he finds the conical lens showing signs of becoming opaque, while in three others there is alteration of size and curvature. In several others the rhabdom affords similar evidence, while in many deep-sea forms the decrease in amount of pigment is also regarded as an indication of degeneracy.

The Northern Limits of the Scorpions.—During a recent collecting trip to the Bad Lands of the Hot Creek Valley, in the extreme northwestern corner of Nebraska, Mr. F. C. Kenyon, a member of the party, found a living scorpion (Buthus sp.). This is, so far as I am aware, some three hundred miles further north than any member of the group has ever been found east of the Rocky Mountains. West of the mountains, I am informed by Mr. Henshaw, they extend north to Oregon and Washington.—J. S. Kingsley.

Glands in Orthoptera.—H. Garman describes, in the current volume of *Psyche*, peculiar glandular structures borne between the ninth and tenth terga of the abdomen of the cave cricket. Their function is unknown; but the author points out the fact that scent glands occur in the females of certain Bombycids. Apparently he is not familiar with the recent literature of abdominal glands in the Hexapoda.

Notes on Tunicates.—Herdman thinks[6] that the usual divisions of the Tunicates, while convenient, do not express the true relationships of these forms. According to him, the Synascidiæ are in reality a polyphyletic group, the members of which touch the Ascidiæ simplices at various points. Hence a strictly phylogenetic classification will

[5] Proc. Zool. Socy. London, 1890, p. 365, pl. XXXI.

[6] *Nature*, June 11th, 1891.

ignore the Ascidiæ Compositæ of our text-books, although the division may be retained for convenience.

Walter Garstang[7] gives the first part of a review of the Tunicata of Plymouth, England. Species of the families Clavellinidæ, Perophoridæ, and Diazonidæ are enumerated and described at length. Pycnoclavella is a new genus.

W. A. Herdman promises a monograph of the British Tunicates.

The Affinities of Polypterus.—H. B. Pollard has studied some points in the structure of Polypterus which, he thinks,[8] throw light upon the relationships of this form. The ear, except in lacking the ductus endolymphaticus, is distinctly Urodele in its character, as is shown by the immense sacculus, which reaches the level with the semicircular canals, and by proximal division of the auditory nerve. The so-called opisthotic corresponds to the Urodele petrosum; the opthalmicus profundus and superficialis pass through a foramen into the nasal capsule; the supracranial fontanelle is partially roofed over by cartilage; the "paired vomer" is really dermopalatine, and corresponds to the so-called vomer of the Batrachia. The jaw muscles correspond to the Batrachian rather than the Teleostome type, while the nervous system corresponds almost to detail with that of larval Salamandra. The conclusion to be drawn from these facts is that the ancestry of the Urodeles must be sought in Crossopterpgians. Turning now to the affinities of the other piscine forms, Pollard promises to show homologies of Polypterus with the Stegocephali, while the position of the Dipnoi and Holocephali must be different from that usually accorded them. Chimæra, etc., are Dipnoan forms which have lost their dermal bones, and are retrograded in some respects toward the Selachian type. If the Dipnoan forms are to be regarded as ancestors of the Batrachia, we should expect to find in the larval Urodeles the same relations of quadrate and palatines to the cranium, but such is not the case. In the young Cryptobranchus the quadrate has nearly the same relationships as in Polypterus. The suprapharyngobranchial I. articulates with the auditory capsule, and from it the author traces the origin of the Urodele stapes. This paper is a sample of the errors into which it is easy to fall in ignorance of the facts of paleontology.

The Pineal Organ of Ichthyophis and Protopterus.—Burckhardt thinks[9] that all previous authors have mistaken an arterial

[7] Jour. Marine Biol. Assn. United Kingdom, 1891, Vol. II., p. 47.

[8] *Anat. Anzeizer*, VI., 338, 1891.

[9] *Anat. Anzeiger*, VI., 348, 1891.

plexus for the pineal organ in these forms. In Ichthyophis, on account of the enormous folding of the arterial plexus the roof of the thalamencephalon is completely covered. It falls into an anterior wall, embraces the ganglia habenulæ on either side, and a posterior wall between the posterior and superior commissures. At the spot where these swellings meet is a small pear-shaped vesicle, which extends into the space between the hinder part of the arterial plexus and the roof of the thalamus. Development shows that this is the pineal organ. In Protopterus the pineal organ is a small, irregular sac, which extends directly upwards from the boundary between the mid- and twixt-brains into the abundant connective tissue of that organ. Burckhardt has not yet traced its lumen into connection with the third ventricle.

Fœtal Period of the Seal.—Grieg has studied the period of pregnancy of *Phocœna communis.*[10] He analyses the known literature, and finds great diversity of opinion. He then studies thirty-five embryos, with dates of capture of the mother, and comes to the conclusion that the period is about nine or ten months. According to the Norwegian fishermen, copulation takes place usually in July and August; but he finds that the breeding season may extend, according to locality, from July to October, and the young are born from March to June. At the time of birth the young measure from 700 to 860 millimeters, and may reach a length of 880 millimeters.

Extent of the South American Fresh-Water Fish Fauna.—There are more fresh-water fishes in the neotropical than in any other region. A comparison made by Carl and Rosa Eigenmann of the latest lists of European and North American fresh-water fishes, with a list of the South American species, shows the extent of the South American fauna. In summing up the species they find 126 European, 587 North American, and 1,147 South American species. (Proceeds. U. S. Nat. Mus., Vol. XIV., pp. 1–81.)

The Chromididæ of the Fresh Waters of Madagascar.—One of the most interesting peculiarities of the fresh-water fish fauna of Madagascar is the presence of the Chromididæ, coincident with the absence of the Cyprinidæ and the Characinidæ, although these two groups are found in Africa, and the great paucity of Siluridæ, so that the Chromididæ are, so to speak, the only fresh-water fishes of this large island.

At the present time the Chromididæ are a family of South America and of Mexico, 230 species out of 260 having been described from that region.

[10] *Jena Zeitschr.*, XXV., 544, 1891.

Known for some years past by a single species referred to one of the most widely distributed forms in Africa, *Chromis niloticus*, the Chromididæ are to-day represented in Madagascar by nine series belonging to four genera, the affinities of which are as follows:

The Paretroplus are distinguished from the Hemichromis, which belong to Africa and to Asia Minor, by a greater number of anal spines. The Paretroplus belong to an African type.

If the Paratilapia have certain affinities with the Hemichromis, they are still more closely allied to the Acara, from which they are distinguished only by the indentations of the bony projections of the external branchial arch; but the Acara belong to tropical South America.

The Paracara also have close affinities with the Acara.

As to the Ptychochromis, Steindacher has shown that they are separated from the Chromis by the presence of a lemelliform, compressed projection from the upper part of the first branchial arch. This character is found in the genus Geophagus, from South America.

The genera of the Chromididæ peculiar to South America have ctenoid scales, while those of Africa and Western Asia have cycloid. Among the Chromididæ of Madagascar, the Paretroplus, we may say, belong to the African type, as they have cycloid scales. All the other Chromididæ of Madagascar have ctenoid scales. Thus the Chromididæ of Madagascar are more closely related to the fresh-water species of tropical South America than to the African species.

From a study of the herpetological and ichthyological fauna of the fresh waters of Madagascar, it appears that this island, Southern Africa, and South America formed in a pre-Tertiary epoch, parts of the same continent, which had a fauna of the same origin and character. While South America and Africa have received since the Pliocene epoch invasions of animals of another creation, Madagascar has had, on the contrary, no connection since that epoch with any other land, and presents to-day the same fresh-water fish fauna as it did in the Middle Tertiary, without any addition save that of the Carassius recently introduced. The division between Madagascar and Southern Africa must have happened before the commencement of the Miocene, for neither Cyprinidæ or Characinidæ are found in Madagascar. Communication must have lasted for a much longer time between South America and the South of Africa, which, toward the Pliocene epoch, had received an influx of Characins; whilst the Cyprins, introduced into Africa from the European continent, or rather from the South Asiatic, had hardly penetrated South America. (Dr. H. E. Sauvage, Bull. Soc Zool. de France, 1891, p. 190.)

EMBRYOLOGY.

Notes on the Development of Engystoma.—This interesting Batrachian occurs in the Piedmont section of North Carolina, near Littleton, and within twelve miles of the southern boundary of Virginia. Its presence after a rain may be discovered by its peculiarly plaintive note. Oviposition seems to occur in the evening and during cloudy afternoons. It is now late in July, yet two lots of ova have been found by me which had been very recently deposited by the parent female "frog-toad," as it is known here amongst the natives. The eggs are heavily pigmented at the upper or animal pole, being darker than the eggs of Rana, and also considerably smaller. They are laid in strings, but so coiled as to form a nearly complete single layer over a considerable surface of water. The gelatinous coating, as in Rana, spreads out under the surface of the water, where by its adhesion to the layer of molecules at the surface a certain amount of support is thus gained for the eggs. It is therefore evident that surface tension is an important agent in keeping the eggs of this genus, and those of Rana, at the surface of the water. Other genera, such as Bufo, do not have the eggs supported on the surface, but are laid in strings formed of one row of eggs, wrapped in a gelatinous cord which lies on the bottom of the pond in which oviposition occurs. Still other forms have the eggs glued together in large masses and supported upon water weeds; this is notably the case with some Urodeles, such as Amblystoma.

The development of the eggs of Engystoma is rapid; three days after deposit the larvæ escape from the egg-envelopes. Throughout the course of development there is well-marked evidence of geotropism, or of the action of gravity in maintaining the equilibrium of the egg. The animal or black pole remains uppermost, the heavier or light-colored vegetative pole remains lowermost; the whole egg is thus maintained in a position of static equilibrium with the earth's center. There seems to be no tendency to rotate the egg through ciliary action, previous to the closure of the medullary folds. That cilia are entirely absent on the eggs of Engystoma is proved by the fact that at the time the medullary groove is still open every egg of the same age is in exactly the same position in respect to the center of the earth, and remains so for a long time, or until the tail fold is well developed and the medullary groove has been closed. Before the closure of the

medullary groove, but after the egg has begun to elongate and the paired, secretory, adhesive surfaces of the under side of the head have appeared as rudiments, the position of the animal and vegetative poles is still the same as in the undeveloped ovum. The head end of the egg is slightly elevated above the caudal end. This is due to the forward growth of the head, and the retention of the heavier yolk, farther backward under the posterior half of the medullary groove. The medullary groove thus comes to be inclined downward a few degrees from the head toward the tail, but the groove looks exactly toward the zenith, while the yolk looks downward in every egg, even the inclination of the medullary groove with respect to the horizon being the same for every egg of the same age.

At this stage I neglected to note an extremely important fact,—viz., whether the cephalic and caudal poles of the same row of eggs were all of them lying in the same direction. The fact that no change of position occurs for a long time in the eggs of Engystoma would indicate that possibly we might find that the future cephalic pole of the egg bore a constant relation to the cephalic pole of the parent Engystoma, such as is known to be the case in *Batrachus tau*. Such relations between parent and offspring exist to a marked degree, if they are not universal, in plants, and it is desirable to know to what extent the same rule holds with respect to animals. According to what has preceded, the early development of Engystoma is peculiarly favorable for the purpose of testing the theory that the cephalic and caudal polarities of the parent are transmitted directly to the offspring, or that the future long axis of the embryo already conforms, even in the egg, to that of the parent.

The next step in the development of Engystoma is somewhat similar to that of Rana. As soon as the larvæ have the tail-fold well developed they turn over and lie on the side, curved upon themselves, within the egg-envelope. This is the condition of the eggs on the second and early part of the third day. On the third day the larvæ leave the egg, and then tend to fall upon the bottom of the pool or receptacle in which hatching occurs. Soon after this they begin to swim about actively, and, singularly enough, instead of swimming like a fish, for some reason, which it is difficult to make out, the larvæ revolve on their own long axes. This singular mode of locomotion is probably due to the peculiar manner in which the tail is vibrated. This mode of swimming lasts about a day, after which the larvæ begin to swim in the usual fish-like way. At this stage, when the larvæ come to the surface, the head is in contact with the surface of the water, and

when quiescent the axis of the body, when in a condition of equilibrium, assumes an angle of about eighty degrees with the surface. The adhesive organs near the mouth now become functional. Up to this time the light area on the yolk is prominent, and enables one to watch the singular rotation of the larvæ. The head now begins to widen rapidly, and the light area on the belly becomes darker. The tail-fold soon becomes very thin, and bordered all round by a delicate edging of black pigment. The larvæ cease to rotate on the fourth day, and no longer take up their angular position at the surface of the water, and now behave very much like the larvæ of Rana. They are now very heavily pigmented over the whole of the body; the light area over the space where the yolk was formerly placed has disappeared, and the larvæ are now black as seen from above.—J. A. RYDER.

ARCHEOLOGY AND ETHNOLOGY.[1]

The International Congress of Anthropology and Prehistoric Archeology of Paris. (*Continued from page 768.*)

Seventh Question: "Ethnographic Survivals Which Can Throw Light Upon the Social State of the Primitive Population of Central or Western Europe."

M. Hassler, of l'Assomption, opened the discussion of this question with a general presentation of the subject.

M. Lumholtz, of Christiania, Norway, gave a long and interesting description of his four years' residence in Australia.

M. Glaumont, of Bourail, presented the result of his studies of the usages, customs, and manners of the neo-Caledonians. M. Glaumont presented a series of fetiches which were used by the people.

Signor Belucci, of Perugia, presented a catalogue of his grand collection of amulets displayed at the exposition.

Dr. Hamy recalled a discussion which had taken place at the Society of Anthropology upon the subject of the savages of Mariannais, whom it was sought to prove were men living in ignorance of the use of fire; but Dr. Hamy presented a large fragment of pottery which had very evidently been made by fire and subjected to its use in cooking or otherwise.

M. Chily Naranjo, from the Canary Islands, recalled the conclusions which had been presented to the congress of 1878 by M. Verneau

[1] Edited by Dr. Thomas Wilson, Smithsonian Institution.

upon the subject of anthropology of the Canary Islands. He ranged himself on the side of M. Verneau in the belief that the Guanche population of these islands at the moment of their discovery were of the race of Cro-Magnon, and had come to a slight degree of higher civilization.

M. de Zmigrodski, of Cracow, presented a large chart of the objects which had been exposed at the exposition, containing the designs of more than 300 objects on which were the sign of the *svastika*, or ancient cross. He divided these into five parts: Asia Minor and its influences, the Greco-Roman epoch, Christian epoch, the prehistoric in Europe, and the contemporaneous of the nineteenth century. Several members expressed doubt as to the conclusions of this gentleman.

M. Dumoutier presented to the congress the costume of a woman of Muong, of Western Tonkin, which was ornamented with *svastikas*.

Mr. Jammes, of Realmont (Tarn), had spent many years in Cambodia, and had made many and extensive excavations in his search for evidences of prehistoric man in that country. He presented many of the objects which he had found and brought back. The collection was purchased by me for the United States National Museum; and these objects, with the locality whence they came, were described by me in the NATURALIST for March, 1890, p. 286.

M. Belucci announced the discovery of a number of flints chipped by intention. The discovery was made by MM. Cuchi and Biauchi, Italian travelers, in a locality named Denghis, in a high valley of the Abai Abyssinia. These chipped flints were in every way comparable to those of the prehistoric ages of Europe.

Eighth Question: "To What Extent do Archeologic or Ethnographic Analogies Sustain the Hypothesis of Relations or Migrations Among Prehistoric Peoples?"

M. Ernst, of Caracas, opened the discussion by a memoir on the ancient inhabitants of Merida, in Venezuela. The author occupied himself especially with small vases in the form of cuvettes, with legs, the extremities of which were joined between themselves by transverse pieces which formed a square, with angles more or less round or occasionally a circle. M. Ernst described three known types of these vases, their ornaments in relief, their colored designs, and gave reasons for the belief that these were objects of luxury, possibly of religion or cult. The distribution of the original type in Venezuela, in Costa Rica, and possibly in the countries of New Grenada

and Chiriqui, appears to assign to these ancient populations a community of origin.

Their language seems to confirm these ideas. The currents of the dispersion of this human family should have taken rise in the center of South America, from which they were directed from the north and the northwest.

M. Verissimo, of Para, said: "There are two Indian families in juxtaposition in Brazil. One of these is the Tupi Guaranis, who speak the *lingoa geral;* the other is that of the Tapouis,—that is to say, the barbarians, to which belonged, possibly, the men of Sambaquis."

The pottery discovered in the Isle of Marajo, at the mouth of the Amazon, and of which M. Verissimo presented a remarkable specimen, appeared to indicate other affinities than those from the north. The prehistoric men of Marajo had probably come from Central America, and followed the coast of the Atlantic. Among the discoveries which tend to confirm this hypothesis, M. Verissimo cites the implements of wrought jade which were met with in Brazil, and of which he presented a specimen sculptured in the form of a batrachian or frog.

M. Hamy observed that the figure of the object presented by M. Verissimo was sufficient to justify the supposition of a northern or western origin, as had been attributed to it by Verissimo,—that is, in the Antilles on the one part, in the Cundinamarca and Central America on the other, where abound those representations of the frog which have a role so important in the mythologic iconography of Central America. The representations of the frog in the New World authorizes the formula adopted by this question, "The Hypothesis of Prehistoric Migrations."

M. L. Netto, of Rio Janeiro, had some words to say upon the communication of M. Verissimo, upon the Sambaquis or shell-heaps of Brazil, and presented a number of objects found during their excavation, and particularly a grand fetich of the form of a fish, others of mortars in the form of fishes and birds, which could be nothing else than the work of actual savages. As to the question of the expansion of jade or jadeite in South America, M. Netto was of the opinion that it is a phenomenon that has not yet been satisfactorily explained.

Baron de Baye recalled and recited the theory adopted by Professor Putnam as to the Asiatic origin of the mineral of which these objects were made in Central America.

Dr. Gosse, of Geneva, was of the opinion that the question now under discussion was not more advanced in America than in Europe,

and that the origin of these hard stones employed in Europe during the age of polished stone is as yet undecided and much to be discussed.

Mr. Thomas Wilson described how the nephrite implements were used in Alaska, and how the mineral of which they had been made had been found by Sir George Dawson, in the form of smooth and worn pebbles, in the valleys of the Lewis, the Kowak, and the Yukon rivers. He said that Dr. Gosse was right to advise us to wait for further information. The elements of jadeite and nephrite were quite common. Why was it that these rocks should not be found in America as well as in Europe?

Mr. George F. Kunz, of New York, presented to the congress a votive hatchet in jadeite, beautifully sculptured, of extremely large dimensions, from Canada. It was his opinion that this mineral came from the southern part of Mexico; but the Mexicans of modern times had never yet discovered its origin. It might be perhaps upon the summit of some mountain. He continued by giving a description of several new minerals, similar to jadeite, which had been used in America for such implements, and have been identified by Professor F. W. Clarke as pectolite, wollastonite, pagolite, and agalmatolite. Implements made of these minerals have been found in divers portions of the United States of America, and therefore there was nothing curious or wonderful in finding the origin of the jadeite and nephrite in that country.

M. Netto presented a portrait of a woman of the tribe of Indians of Boticude, and with it gave a description of what was called the *botoque*, which much resembles, if it was not actually, a labret; and he said that many American people used it in distant portions of the country. In this he was supported by Dr. Hamy, who presented several curious specimens from his museum of ethnography, and especially those from the northwest coast of America. Both Dr. Hamy and M. Netto were, however, in doubt whether these objects would show a relationship between two peoples so widely separated.

Mr. Thomas Wilson instituted a parallel between the paleolithic period in the United States and that in Europe. This period has been manifested in the United States of America by implements found deep in the river gravels at three places or more at great distances from each other,—the Delaware, the Miami, and the headwaters of the Mississippi Rivers. He described these localities and the conditions of and associations in which the paleolithic implements were found,—likeness between them and paleolithic implements in the river gravels in Europe. Their appearance, mode of manufacture, were much the same. The difference

between them was principally that of material, and this was in some cases much the same; for argillite implements were found at Trenton, while the quartzite implements of Piney Branch would compare in all respects with those found by MM. d'Ahemar, Noulet, and Cartailhac in the valley of the Garonne. Mr. Wilson continued his discourse at some length by the comparison of the neolithic types from America with those of Europe. Many of both kinds were shown, some by the original and others by photographs and drawings.

M. Verneau discovered in the islands of the Canaries the polished stone hatchets of which the material, form, and work recalled those which were found in the Antilles, and, above all, at Porto Rico. There were other things of the same order which showed analogies, particularly the *pintaderas* of the Canaries, with the imprints of the ancient Mexicans.

M. Cartailhac gave a resume of the researches which he had just terminated upon the prehistoric archeology of the Balearic Isles, and proved that all the affinities of the archipelago were with the south. He had not found a trace of the age of stone, and the grand monuments had an African aspect or appearance.

M. Tardy dilated upon the beginnings of civilization in Algeria, and the synchronisms of the first stages of the earlier ages of humanity in Africa and in Europe.

M. Belucci presented a note upon the relations between the central and southern portions of Italy at the epoch of the polished stone. These relations are established not only by the obsidian of Lapiri, which came from Central Italy, but also by the particular forms of arrowheads, and by the scrapers and knives of a variety of flint which had its origin in the southern provinces; finally by the polished stone hatchets of the form *bombé*, which were common in Southern Italy, and which were met, though rarely, in Central Italy.

M. Adrien de Mortillet communicated a summary of the results of a mission which had been confided to him by the Commission of Megalithic Monuments: to study the monuments of the same nature in Algeria, and to compare them with those of France.

M. Hamy did not agree with these conclusions, and he commended conservatism in our opinions, and advised us to guard against generalizations in regard to prehistoric monuments of countries which, though neighbors, yet offer from the archeologic point of view such profound differences.

PSYCHOLOGY.

Note on the Evolution of the Upright Tail in the Domestic Dog.—My attention has recently been called to the work on "Organic Evolution" by Professor Eimer, page 114, to a paragraph in which he seems unable to account for the dogs in Constantinople carrying the tail upright. In speaking of the subject he says: "But the reason why these dogs begin to erect the tail and carry it upright, while the ancestral jackal, like the wolf, carries it hanging down, is not so easy to discover, although the fact could scarcely be explained as a case of adaptation." I beg to offer a provisional explanation of this phenomenon, and also to take exception to the latter statement,—that it cannot be explained as a case of adaptation. While my observations were not made at Constantinople, the dogs accompanying the several tribes of Indians I observed in the Western United States,[1] some of which are tamed wolves, or are directly descended from the wild American wolf known as the coyote, offer opportunities of study which brought me to a realization of this subject, which may be summed up in a few epitomized remarks.

As the dog becomes domesticated it is prone to use the tail as an organ of expressing mental states, especially those of emotion; for example, the wag of the tail expressive of delight, or sudden dropping of the tail between the legs at some disappointment or fright. The ancestral or wild wolf carries the tail hanging down, because that position (the tail being especially bushy and large in the wild animal) would be less conspicuous and more compatible with life in a free state of nature, or, as it were, to better elude detection. A family of wolves playing together undisturbed occasionally carry their tails curled upwards. By degrees the tail acquires naturally the upright position as a result of coincident evolution of the mind of the wolf incidental to domestication, and moreover thus instancing the slow adaptation of the appendage as an organ of expression. The cessation of natural selection in the domestic dog would give to the tail greater freedom of motion without detriment to life; and artificial selection perfects the caudal appendage into many diverse shapes. Still greater influence is exerted by certain expressions of the mind by that appendage, tending to keep it up, and by the influence of heredity, transmitting those tendencies. The muscles correlatively become strengthened and developed, and the erect position ultimately passes into an apparently fixed character in some varieties of the dog.—Dr. Joseph L. Hancock, *July 10th, 1891.*

[1] The words dog and wolf are used synonymously in this note.

MICROSCOPY.[1]

Fixation of the Methylenblue Stain.—In the last number of the *Zeitschrift für Wissenschaftliche Mikroskopie* (Vol. VIII., 1, 1891, p. 15), Prof. Dogiel offers some new points on the use of methylenblue in staining nerves.[2]

Nerves exposed to the direct action of methylenblue often stain so intensely that they appear dark blue, almost black. Such preparations should lie in the fixing medium (saturated aqueous solution of picrate of ammonium) twenty-four hours or more, otherwise the color fades quickly after transfer to glycerine. Long exposure to sunlight causes the stain to fade.

The fixing medium often macerates, loosening the epidermis and rendering difficult the investigation of intra-epithelial nerves. The macerating effects may be checked by adding osmic acid (1-2 cc. of a 1 per cent. solution to 100 cc. of the fixing fluid). This mixture preserves the tissue, and at the same time blackens the medullary sheaths of the nerve-fibers. As the axis cylinders stain dark violet, it becomes easy to distinguish medullated from non-medullated fibers. The preparations are mounted in dilute glycerine.

If the tissues are to be prepared for sectioning, a stronger per cent. of osmic is added (1-2 cc. of a 1 per cent. solution to 25–30 cc. of picrate of ammonium). The preparation lies in this fluid twenty-four hours, and is then cut in liver or pith, or with the freezing microtome.

Biedermann[3] recommends as a fixative in the case of invertebrates the following mixture:

Saturated aqueous solution of picrate of ammonium	1 vol.
Glycerine	1 vol.
Solution of salt, ½ per cent. (sea-water in case of marine forms)	2 vols.

The nervous system is dissected out for exposure to the staining fluid. That the exposure may be as direct as possible, the nerve-cord (Hirudo, Lumbricus, etc.) should be freed from its sheath. A very dilute solution of methylenblue is used, and allowed to act from two to three hours. If the preparation, after the exposure, be placed on a slide wet with the staining fluid, and left for one-half to one hour in a moist chamber, the color effects will be intensified. This

[1] Edited by C. O. Whitman, Clark University. Worcester, Mass.

[2] Cf. this journal, Dec. 1890, p. 1219.

[3] *Jenaische Zeitschrift für Naturwissenschaft*, XXV., 3 and 4, 1891, p. 433.

"airing" is not required with marine animals, as with them the color differentiation is completed in the staining fluid.

In the case of marine animals the methylenblue is dissolved in sea-water. It dissolves less readily than in fresh water, and owing to this weak solubility it is liable to form a fine granular or crystalline precipitate on the surface of the preparation. As a large part of the dissolved staining substance is lost by filtering, it is best to prepare it fresh each time, and to allow it to settle, so that the clear fluid can be turned off for use. In the case of Nereis the nerve-cord is not obscured by a thick opaque sheath, and hence it is only necessary to open the dorsal wall lengthwise and spread it out flat in order to apply the stain.

Vasale's Modification of Weigert's Method.[4]—The pieces of the nervous system to be prepared are hardened in Müller's fluid or in bichromate of potash, and then, either with or without washing, left in alcohol until they are wanted for sectioning. For staining, the three following fluids are required:

1. Hæmatoxylin 1 g., dissolved in 100 g. water by heating.
2. Neutral acetate of copper, saturated, filtered solution.
3. Borax 2 g., ferricyanide of potash 2½ g., dissolved in 300 g. water.

The sections taken from alcohol are placed in solution 1 for three to five minutes; then for the same time in solution 2, in which they become black. They are next washed quickly in water and put into solution 3, which is stirred, and in which the ganglion-cells, neuroglia, and the degenerated parts are quickly discolored, while the medullated fibers remained stained dark violet. Finally the sections are washed in water and quickly placed in absolute alcohol. They are cleared with *carbol-xylol* (three parts xylol to one of liquid carbolic acid), and mounted in xylol balsam. This clearing mixture has the advantage that it does not shrink sections inclosed in celloidin. A contrast-stain may be obtained if the sections, after being washed, are treated with alum carmine or picrocarmine, or according to Pal's method.

Upson's Gold-Staining Method for Axis-Cylinders and Nerve-Cells.[5]—Pieces of the central nervous system are hardened in potassium bichromate, beginning with one per cent. and increasing to 2½ per cent. They are left in this fluid in the dark from four to six

[4] Rivista sperimentale di Freniatria e di Medicina legale, Vol. XV., 1889., p. 102–5. *Zeitschr. f. Wiss. Mikr.*, VII., 4, 1891, p. 518.

[5] A. Mercier. "Die Upson'schen Methoden für Achsencylinder und Zellen (Gold) Färbung. *Zeitschr. f. Wiss. Mikr.*, VII., 4, p. 474, 1891.

months, then washed quickly and placed in alcohol of 50 per cent. two to three days, which should be renewed a few times. They are then transferred to 95 per cent. alcohol, and left until they show plainly a greenish color (two to four weeks or more).

The preparations are then ready for sectioning, and may be cut without imbedding, or after imbedding in celloidin. Two methods of staining are used:

1. The section is placed in a one per cent. solution of gold chloride, to which two per cent. hydrochloric acid has been added (about two hours), then washed in distilled water, and transferred to a ten per cent. solution of potash for half a minute.

The section is then washed in distilled water, and there left until the following reducing fluid (to be made fresh each time) is prepared:

Acid. sulfurosum . . . . 5 cc.
Tinct. iodi., 3 per cent. . . . . 10–15 drops.

Mix, and add

Liq. ferrichlorid. . . . . 1 drop.

This fluid must be made very exactly and quickly, and the moment it is ready the section is placed in it and left until it assumes a rose color. If left only a few seconds too long it becomes dark red, and is worthless.

As soon as the proper color appears the section is transferred to distilled water, and then to absolute alcohol on the slide. After ten to fifteen minutes it may be cleared in clove oil and mounted in balsam. The slide is to be kept in the dark.

2. The section is placed for two hours in the following solution:

Gold chloride, 1 per cent. . . . . 5 cc.
Ammonium vanadicum, saturated solution . . 10 drops.
Acid hydrochlor. . . . . 3 drops.

Wash, and transfer to the following (freshly prepared) mixture for ½ to 1 minute:

Caustic potash, 10 per cent. . . . . 5 cc.
Ammonium vanadicum . . . . a trace.
Permanganate of potash, 10 per cent. . . . . 10 drops.

Wash, and expose to the following reducing fluid, freshly prepared:

Tin solution . . . . 15 drops.
Aq. dest. 3 cc.
Iron solution . . . . 3–5 drops.
Acid. sulfurosum . . . . 3 cc.

The moment the acid sulfurosum is added a thick precipitate arises, and at this moment the reducing fluid is strongest.

The method of handling the section is the same as in method 1.

The tin solution is made by adding so much chloride of tin to three per cent. tincture of iodine until the color is white or yellowish. The iron solution is a saturated solution of ferrum phosphoricum in distilled water.

The method is somewhat cumbersome, but the results are said to be extraordinary.

Method of Preparing Rotifers.[6]—The first difficulty which one experiences in studying the rotifers is their constant motion. This difficulty is overcome, according to Masius, by the use of a mixture of methyl alcohol, water, and cocaine in weak solution.

After being anæsthetized by this fluid, the rotifers may be fixed without contraction in the ordinary preservative fluids,—Flemming's fluid, for example.

For the study of the head, an anæsthetized specimen is placed upon a slide, and the head cut off in a transverse plane as near as possible to the anterior end. The section thus obtained can be examined easily from any side in water or weak alcohol.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island.—April 11th.—Mr. Arthur Hollick stated that a nest of the barred owl (*Syrnium nebulosum*) was found on Staten Island, March 27th, by Mr. Chas. Rufus Harte, a student of Columbia College, This is an addition to the list of birds known to breed here, and the following memorandum from Mr. Harte was read :

" In the woods which are the continuation of the swamp (near Bull's Head) I came upon a sweet gum, having an 'owlish' looking cavity. As I turned aside to investigate, a barred owl flew out and away into the depths of the woods, appearing again once or twice, but always at a very respectable distance. The tree was about two feet in diameter, with no limbs below the opening, which was some thirty feet up, and very irregular in form. The cavity into which it opened was about eight inches in diameter, and was filled to within six inches of the mouth with dead leaves and feathers. On this bed lay the three

[6] *Arch. de Biol.*, X., 4, 1890, p. 652.

eggs, which were nearly hatched and very dirty. I did not see any remains of birds or mammals either in or about the nest."

May 9th.—A communication was read from Mitchell's Book Co., 830 Broadway, N. Y., stating that they had the original deed of sale of Staten Island by the Indians, in 1670, and inquiring if the association desired to purchase or copy it. The corresponding secretary stated that he had requested Mr. E. C. Delavan, Jr., to examine the document, with the following result:

56 Wall Street, New York, May 9th, 1891.

ARTHUR HOLLICK, Esq., New Brighton, N. Y.:

DEAR SIR:—I have examined the conveyance in possession of the Mitchell Company, 830 Broadway, referred to in their letter to you. While the document presents many internal evidences of authenticity, two points strike the professional reader as odd. In the recital of parties the names of the grantees are first written, followed by the names of the grantors. The grantees are Governor Lovelace and James Duke of York, the former representing the latter. The grantors are various sachems.

The second point that seems to me unusual is that no totems have been drawn by any of the sachem grantors, and in their place are the ordinary marks that would likely be adopted by any illiterate.

Granting the authenticity of the document, what is its value? The price placed on it by the company is $600. Its highest interest attaches when it is viewed from a purely antiquarian standpoint. Historically its interest is secondary. The first grant of Staten Island to Michael Pauw (1629–1630) was conditional on his acquiring the Indian titles, which we must assume that he accomplished. Pauw subsequently reconveyed to the West India Company (see Gay's History). After the English ousted the Dutch authorities a conveyance by the Indians of Staten Island to Governor Lovelace, before 1760, is said to have been made, followed by a deed of confirmation in 1760 (see Clute). The latter is probably the same instrument now under consideration.

From the lawyer's standpoint Indian deeds are now of little or no practical importance. It has been held that the Indians had no title which would be recognized in the courts of this country. The only legally recognized title was that of discovery and conquest. (Trustees of the Freeholders and Commonalty of the Town of Southampton, respondents, *vs.* The Mecox Bay Oyster Company, 116 N. Y. Johnson *vs.* McIntosh & Wheat (U. S.), 543. Martin *vs.* Waddell, 16 Peters 367.)

Very truly yours,

EDWARD C. DELAVAN, JR.

Mr. Arthur Hollick read by title a list of 35 fungi collected at Tottenville, October 4th, 1890, and determined by Chas H. Peck, State Botanist. This will be published as a "special" at some future date.

Mr. Hollick presented a specimen of *Spirophyton caudagalli*, found on the shore of Tottenville,—an addition to the local list of paleozoic fossils found in the Drift.

Mr. L. P. Gratacap showed specimens of *Lymnæa palustris*, and read the following memorandum: The *Lymnæa palustris*, which was found last autumn by Mr. Davis in the brook that courses along Washington Avenue, and which was identified by Mr. Sanderson Smith, has been kept in confinement by me during the winter. The tank in which the individuals were placed was kept in a very cold room and partook of of the changes in the winter weather. Two only survived the experience, and these have not hibernated, but maintained a sluggish life all winter. This spring seven gelatinous capsules exuded, each containing about twenty-five embryos. Amongst the authorities the opinion seems entertained that adults do not generally live over the winter, and that maturity is reached in one year. This opinion seems very questionable. The species may repay some attention. On this continent it ranges as far north as Great Bear Lake in Canada, and in the United States extends from New England through Pennsylvania and Kansas to California and Oregon. Abroad it ranges from Siberia to Algeria and Sicily. About five varieties are recorded by writers. The black patches of Lymnea upon the cement blocks just under the overflow from the new pond recently made in the Snug Harbor clearings, south of Castleton Avenue, may also prove to be this species.

Mr. W. T. Davis noted the Carolina wren, as an addition to the list of birds known to breed on the island, and read the following note:

On the 26th of last April I discovered a family of Carolina wrens (*Thryothorus ludovicianus*) on Richmond Hill near the old British fort. One of the parent birds was perched on top of a small Ailanthus tree calling vociferously, while the other accompanied the young, which were hidden in a thick growth of low briers, grass, etc., in and out of which they crept. They were just able to fly,—indeed, one of them could only do so for a yard or two, and much preferred climbing about the briers. Later in the day the little birds had congregated under a small cedar, whose lower branches touched the ground, but they quickly sought the protection of the briers again when approached. It is hoped that they will not be molested, but continue to abide on Staten Island,

for the Carolina wren remains all the year round where once it has fixed its home.

Mr. Davis also contributed the following botanical notes:

A swamp of three or four acres lies just north of the Amboy road, between Gifford's and the road to Richmond. At present it supports a thick growth of huckleberry bushes, poison sumachs, young red maples, a number of magnolias, etc. Several bushes of the mountain holly (*Nemopanthes canadensis*) also grow there, which species has not before been reported from the island. In July, 1889, the deep red berries were conspicuous; in 1890 the bushes bore no fruit; but on the 26th of April, this year, they were found in blossom. (Specimens were here shown.)

The peat is particularly thick and quaking in this swamp, and fifteen or twenty years ago, before it had been drained so extensively, the pitcher plant (*Sarracenia purpurea*) grew in its northwest corner, as I was informed by a man who lived in the vicinity. The common cranberry also grew there, and the man who told me about the pitcher plant, said his mother used to pick them for family use, but in his time he had never gathered over a handful. Now they appear to be exterminated. There is, however, an unreported patch of cranberries (*Vaccinium macrocarpum*), or perhaps more properly several patches, in the low, open woods between Washington Avenue and the road from Annadale.

SCIENTIFIC NEWS.

There has been no little change among biologists in the United States during the present year. The opening of the Leland Stanford, Jr., University made a number of new positions. Dr. D. S. Jordan, the president of Indiana University, was called to the presidency of the new institution, and so far he has announced the following natural science faculty: J. C. Branner, of Indiana University, professor of geology; O. P. Jenkins, of De Pauw University, professor of physiology and histology; J. H. Comstock, of Cornell, non-resident professor of entomology; C. H. Gilbert, of Indiana University, professor of vertebrate zoology; D.H. Campbell, of Indiana University, professor of cryptogamic botany. Prof. J. M. Coulter, of Wabash College, accepted the presidency of Indiana University; C. H. Eigenmann is appointed professor of zoology, and David Mottier instructor in morphological botany, in Indiana University. Prof. L. M. Underwood, of Syracuse University, goes to De Pauw to take the place vacated by Dr. Jenkins; and Prof. C. H. Hargitt and Mr. O. F. Cook are promoted to the chairs of biology in Syracuse University. Dr. Bleile has been elected professor of comparative anatomy and physiology in Ohio State University. Professor H. F. Osborn, of Princeton, has been elected professor of vertebrate zoology, and Prof. E. B. Wilson, of Bryn Mawr, associate professor of invertebrate zoology, in Columbia College. Prof. E. H. Barbour, of Iowa College, has been appointed associate professor of geology in the University of Nebraska; and H. W. Norris goes to Iowa College as professor of natural history.

Dr. Franz von Wagner is a privat docent in the University of Strassburg.

Peter Martin Duncan, the well-known student of fossil Cœlenterates and Echinoderms, died in London, May 28th, 1891.

Professor Chun's place in Königsberg is taken by Dr. Max Braun, of Rostock, while Dr. Fr. Blochman goes to the zoological chair in Rostock.

Edmond André, the student of the Hymenoptera, died at Braune, January 11th, 1891.

Dr. A. Viallanes has been appointed director of the zoological station at Arcachon, France.

Edward Burgess died in Boston, July 12th, 1891. He was born in Sandwich, Mass., in 1848, graduated in 1871 from Harvard University, and was for several years professor of entomology in the Bussey Institution of Harvard. He was secretary and librarian of the Boston Society of Natural History from 1873 to 1883, when he resigned to devote himself to naval architecture. Mr. Burgess described some Diptera, but the bulk of his work was on the anatomy of insects. He was a careful dissector and a good artist, his "Anatomy of the Milkweed Butterfly," published in 1881, being a good example of what anatomical work should be.

J. M. Stedman, formerly of Cornell University, now of the U. S. Department of Agriculture, has just accepted an invitation to the chair of biology in Trinity University, Durham, N. C. This institution has been completly reorganized, and will open in September with the following new departments: Medical college, law school, schools of arts, literature, political and social science, divinity, and a college of the sciences.

The marine biological laboratory at Wood's Holl, Mass., is enjoying its most prosperous season, some 54 students and investigators being at work at present. The Gifford House, purchased last year, makes fine quarters for the mess, while the Fay and Gardner cottages relieve the pressure for suitable rooms.

Professor W. K. Brooks, with a party of students, went to Jamaica for the summer. The party report good results, but expensive living. Outrageous prices were charged for every building available for laboratory purposes.

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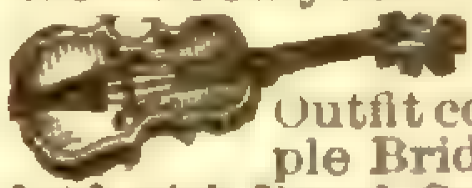

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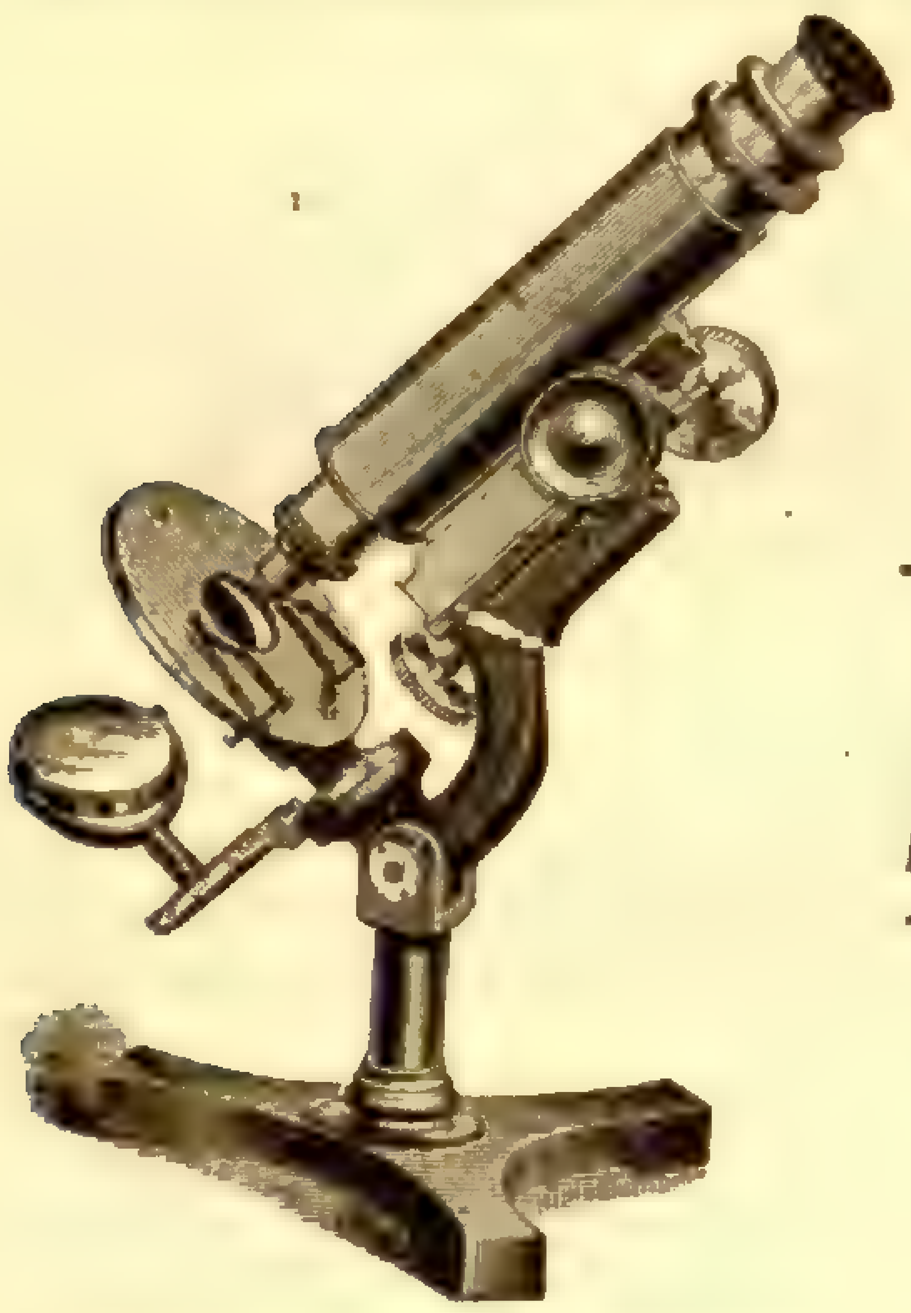

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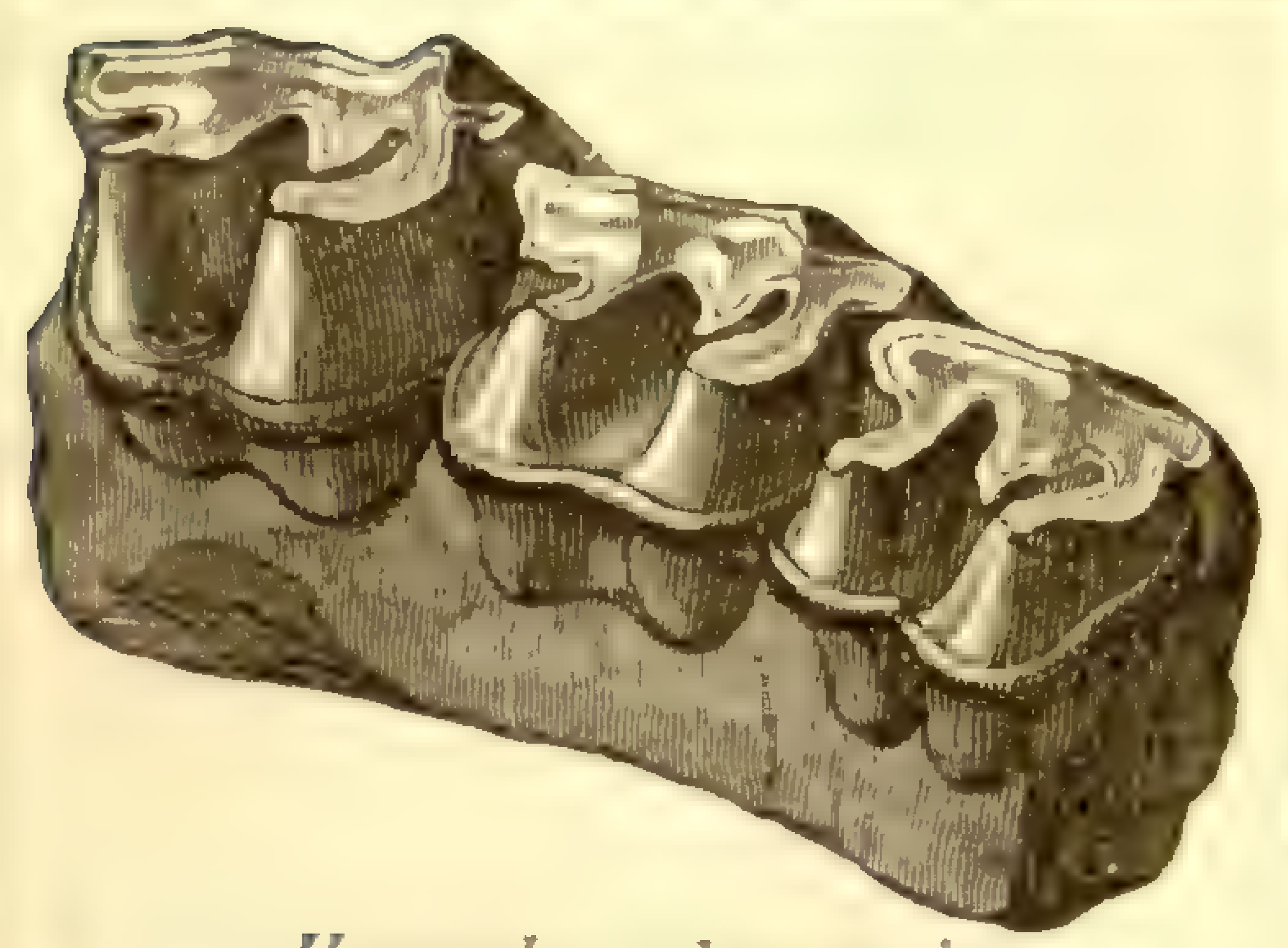

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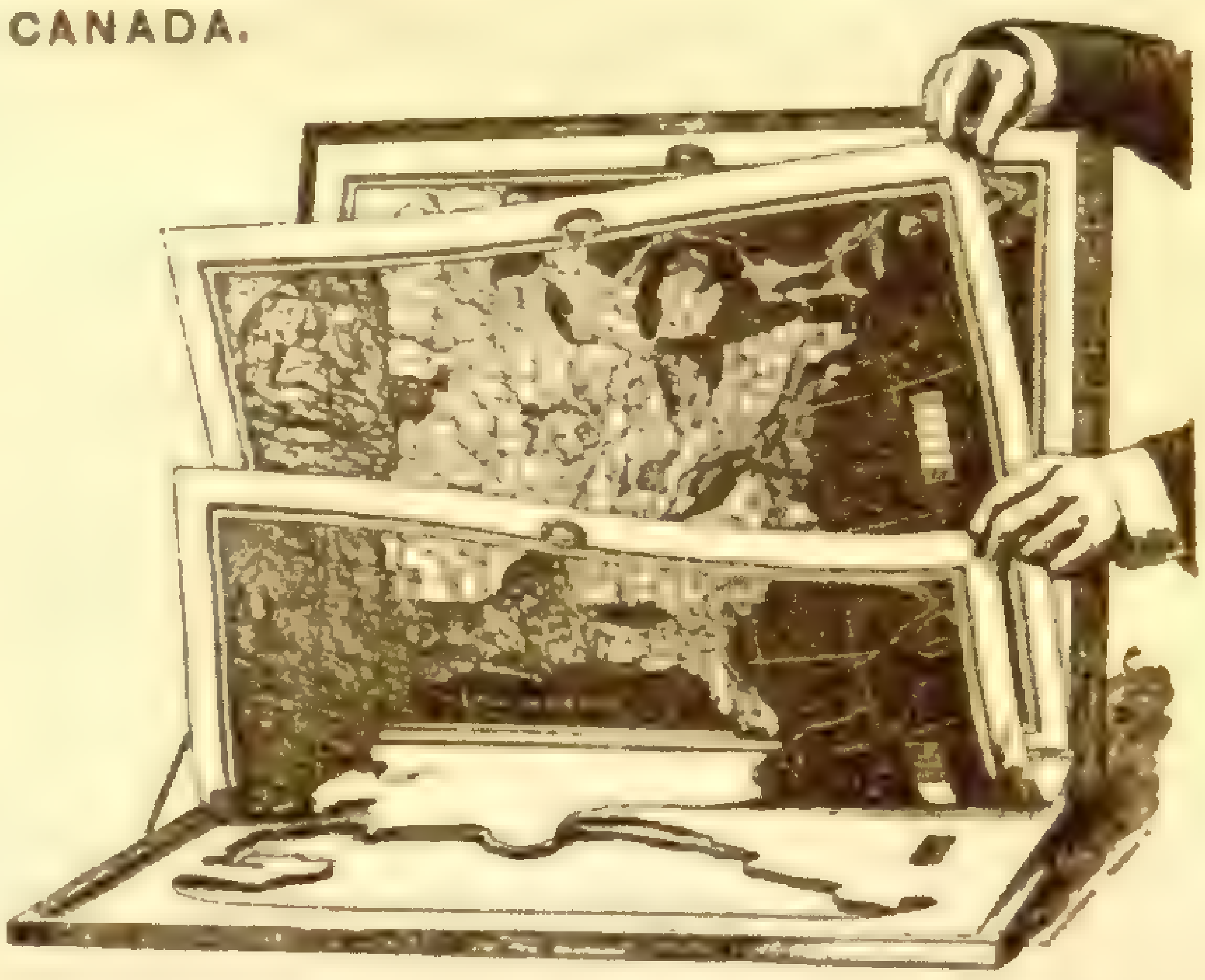

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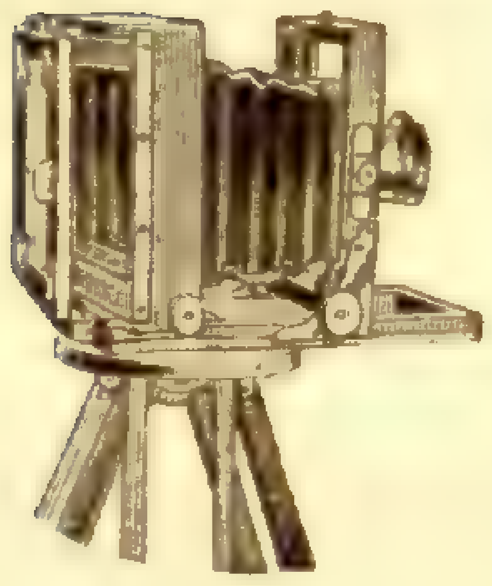

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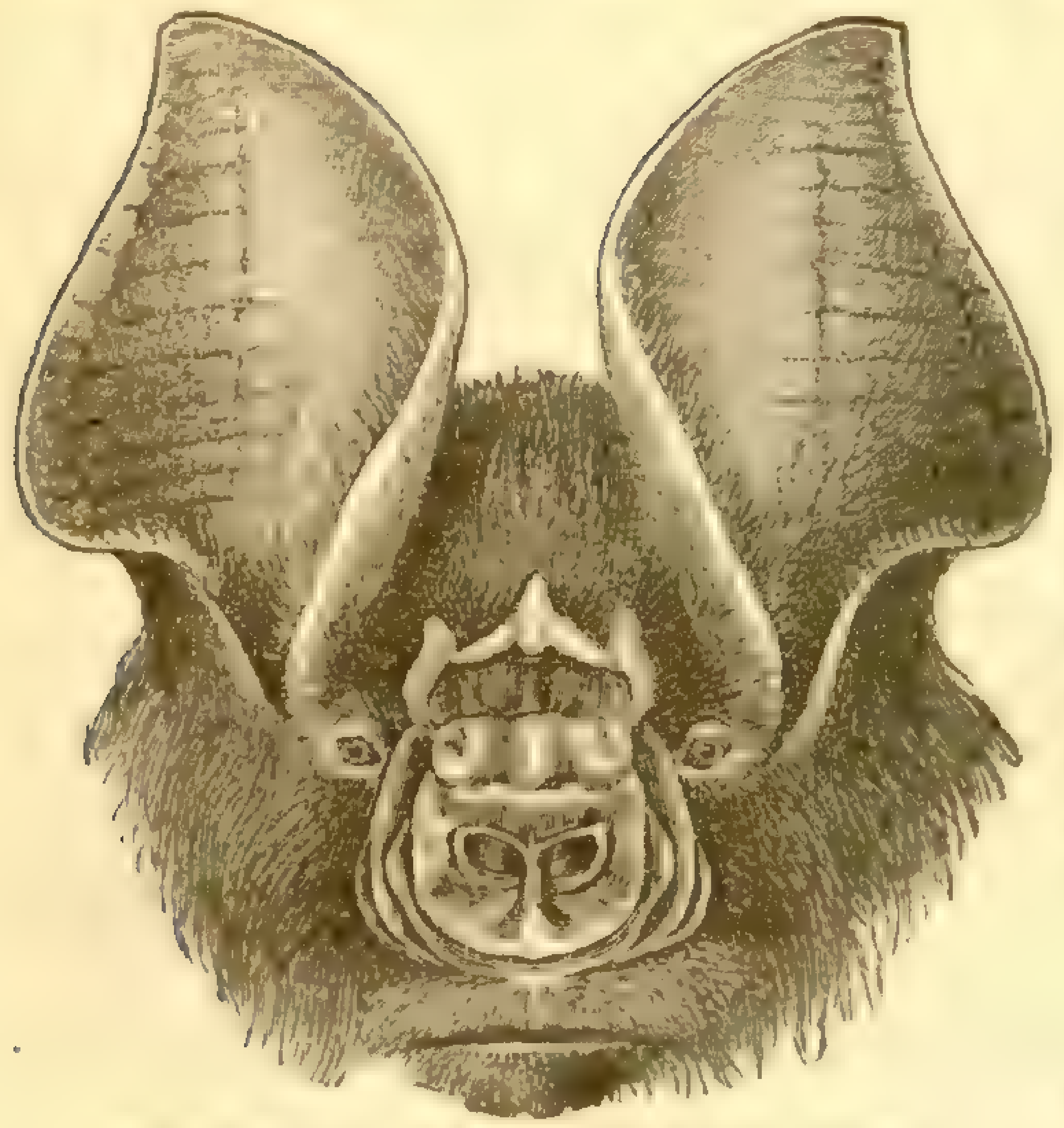

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DR. H. C. HOVEY, in an article in the *Scientific American* of August 29th, says: "A remarkable paper was read at the Washington meeting of the A. A. A. S. by Prof. A. E. Foote, of Philadelphia, describing a new locality for meteoric iron, near Cañon Diablo, Arizona, fragments of which contained diamonds. . . . . . Small meteoric fragments, numbering 131 in all, ranging in weight from one-sixteenth of an ounce to six pounds ten ounces, were scattered over an area about a third of a mile in length and one hundred and twenty feet wide, and extending northwest and southeast. . . . . Exactly in line, but about two miles southeast, were found two large masses, one weighing 154 pounds and the other 201 pounds, which were on exhibition, both of them deeply pitted and the larger one perforated in three places. About 200 pounds of angular oxidized fragments, also of meteoric origin, were found near the base of the crater, a few of which showed a greenish stain from oxidized nickel. . . . . A fragment of a mass weighing 40 pounds was examined by Prof. G. A. Koenig, who found it to be extremely hard, a day and a half being taken in making a section. An emery wheel was ruined in trying to polish the section. This led to closer inspection of certain exposed cavities, where small black diamonds were found. . . . . . The fact of special interest may be accepted as proved,—that diamonds have been found in meteoric fragments. The specimens were carefully examined by the geologists present at the reading of Prof. Foote's paper, and while there were many opinions expressed as to the so-called "crater," and as to its relation to the meteor, none doubted the genuineness of the diamonds."

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THE

AMERICAN NATURALIST

VOL. XXV. OCTOBER, 1891. 298.

A SKETCH OF THE GEOLOGY OF SOUTH AMERICA.

BY GUSTAV STEINMANN.[1]

IN preparing a sketch of the geology of South America I feel obliged to add some explanatory remarks. This sketch accompanies a map which forms a part of the second edition of the Physical Atlas of Berghaus (Gotha, Justus Perthes), which publication will be finished at the end of this year. Besides many other maps, the geological part of this atlas has sketch-maps of all continents, which represent the actual state of our knowledge. In preparing the sheet of South America I was aided by many geologists who, like myself, had occasion to explore some parts of this continent, especially by Orville Derby for the part of Brazil, by Luis Brackebusch for the part of the Argentine Republic, and by many others.

I thought it of some interest to the Association of North American Geologists to explain the main resemblances and differences which exist between the northern and the southern part of the great American continent, and to urge some remarkable points in the geological evolution of South America.

I pass by the primordial rocks, very imperfectly studied as yet in South America. The Paleozoic rocks are better known, and offer great interest. By the investigations of d'Orbigny, Forbes, Kayser, Rathbun, Clarke, Orville Derby, and those made recently by Dr. Ulrich, of Strassburg, upon the rich collection of

[1] Professor of Geology in the University of Freiburg i, B. Read before the Geological Society of America, August 25th, 1891.

fossils I brought home from the central plateau of Bolivia, the two following interesting points have been demonstrated:

1. That nearly all parts of the Paleozoic formations are represented in South America by marine deposits, being known by Cambian, Lower and Upper Silurian, Devonian and Carboniferous fossils. As far as our knowledge extends, the older Paleozoic deposits—*i. e.*, the Cambrian and Silurian formations—are generally more disturbed and metamorphosed than the Devonian and Carboniferous series. In consequence of this fact, the faunas of the latter formations are better known than those of the former.

2. The richest Paleozoic fauna as yet known from South America is that of the Devonian formation. More than 150 different species have been described. The rich and well-preserved fauna collected by me in the eastern part of the Bolivian plateau has enabled Mr. Ulrich to show that the Bolivian deposits form a very important link between those of North America on one side, and those of Brazil, the Falkland Islands, and South Africa on the other side. The highly fossiliferous clay slates, sandy clays, and sandstones widely distributed in Bolivia and Brazil are the equivalents of the Oriskany sandstone, the Upper Helderberg, and the Hamilton groups of North America. Their fauna bears an American, not a European, character, as proved by the two commonest and most characteristic Brachiopods:

1. *Leptocœlia flabellites.* This fossil has been found in North America, Bolivia, on the Falkland Islands, and in South Africa.

2. *Vitalina pustulosa* is known from North America, Brazil, Bolivia, and South Africa.

Partly by the identity, partly by the similarity of the Devonian faunas of the named regions, it appears quite evident that a great Devonian sea embraced large parts of both Americas and South Africa.

The Carboniferous deposits seem to be much more restricted in South America than the Devonian. The sub-Carboniferous is mostly composed of non-fossiliferous sandstones; the Upper Carboniferous, containing representatives of universally distributed Brachiopods and Gastropods, and of the genus Fusulina, is known from Peru, Bolivia, and some parts of Brazil.

During the Permian, Triassic, and Jurassic epochs the greatest part of the South American continent, in the same manner as the North American, was above the sea-level, for according to the researches made by Brackebusch in the Argentine Republic, by myself in Bolivia, and by Derby in the Matto-Grosso region, a great if not the greatest, part of the red sandstones generally considered to be of Permian or Triassic age seems to belong to the Cretaceous formations,—probably to the lower part of it. The flora which existed during the Permian and Triassic periods upon the South American continent is of high interest. The coal-bearing deposits of South Brazil and those of the Argentine and Chilian Cordilleras contain many representatives of the so-called "Glossopteris flora" known from South India, Australia, and South Africa. The age of these coal deposits is not everywhere the same. The flora of South Brazil has been referred to the younger Paleozoic, because it contains some Paleozoic types of plants; those of the Argentine and Chilian Cordilleras belong to the Rhætic group, and are partly covered conformably by marine deposits of the Lower Lias.

Marine deposits of the Triassic and Jurassic formations have only been found in the western part of the continent,—namely, in the Cordillera between the 5° and 35° of southern latitude. The Triassic fossils are of the same type as those found in California and Western Canada, the leading fossil being a species of Pseudomonotis of the group of *Ps. semicircularis* Gatt. From the Jurassic formation nearly all horizons have been found in a fossiliferous state, and the rich collections made in different parts of the Argentine, Chilian, and Peruvian Cordilleras have enabled us to determine that the succession of marine organic life during this period was quite the same on the Pacific slope as in Europe and East India, and there have existed very intimate faunistic relations between these regions. As regards the extension of marine deposits of the Triassic and Jurassic epochs, there exists a remarkable similiarity between North and South America, being themselves confined to a small strip parallel to the Pacific coast.

In contrast to this small extension of marine Triassic and Jurassic rocks, the Cretaceous deposits cover a very large area in South America. Marine Cretaceous fossils are found in nearly all parts of the Cordillera from South Patagonia to East Venezuela, and Mr. White has discovered a rich fauna of the Cretaceous formation of East Brazil. The invasion of continental areas by the sea at the earlier Cretaceous period, which has been observed in many parts of Central Europe, seems to have taken place on a much larger scale in both Americas. We know now, by the investigations of Hill and White, that a part of the Cretaceous strata of Texas formerly regarded as Upper Cretaceous belongs to the lower part of this formation. The Cretaceous formation of Mexico appears as a direct continuation of the Texas deposits; and as far as our present knowledge extends, the relations between the faunas of the older Cretaceous of these regions and those of Venezuela, Colombia, and North Peru are very intimate. It is interesting to see certain characteristic fossils of the Lower Cretaceous of the north reappear in the south. The famous genus Aucella, widely distributed on the slopes of the North Pacific, has been recently mentioned by N. Ritin from Mexico; by White from Brazil; I know it also from the invirons of Lima associated with Ammonites of the Neocomian of Europe. The Cretaceous sea which covered the central part of America probably continued farther to the east. We find, therefore, some remarkable relations between the Lower and Upper Cretaceous faunas of South America, especially of Colombia and Peru, and those of North and West Africa. Some forms of Buthiceras known from Algiers are found abundantly in the Upper Amazonian region. The truly marine deposits of the central part of America disappear to the north and the south, and seem to be replaced by sandy deposits without marine fossils. Probably a great part of the red sandstone formations which occur in Brazil, Venezuela, Bolivia, and in the north of the Argentine Republic, take the same place relative to the marine sediments of the older Cretaceous as do the Atlantosaurus beds, the Trinity and Tuscaloosa formations in the north,—namely, underlying themselves or forming an equivalent of them.

I cannot conclude my remarks upon the Mesozoic formations of South America without mentioning the two following peculiarities. The first is the fact that, wholly independent of the marine Cretaceous deposits of the Cordillera on the Pacific coast of South Chili, glauconitic sandstones are found which contain a rich fauna of the uppermost Cretaceous, especially on the Island of Ouiriquina. Besides many Ammonites and Baculites, partly identical with those from South India, this fauna is characterized by the abundance of Gastropods of a Tertiary type. The Cretaceous beds are covered conformably by a lignitic formation, whose fauna does not contain the Cretaceous fossils; but stratigraphically both formations are intimately united. So a curious parallelism seems to exist in these deposits of South Chili, with the Chico-Tejon group of North California.

The second point to be pointed out is the abundance of eruptive rocks within the Triassic, Jurassic, and Cretaceous formations of the Cordillera. On the western side of the border of Chili and Peru, where the marine deposits of these formations predominate, only a very small part of the rocks are formed by limestones, clay slates, or sandstones. These appear, however, to be interlaid between stratified masses of prophyritic, melaphyric, and andesitic material, the entire thickness of which strata reaches several 1000 meters. So far as we know, this is the largest area of eruptive formation of Mesozoic time. The Cordillera of South America is famous for its eruptive formations of the latest time, but it merits no smaller attention for its submarine eruptions during the Mesozoic time, and for the injection of the Mesozoic strata by truly granitic and dioritic rocks.

The Tertiary formations, well developed in the Argentine Republic, have been subdivided into a number of groups by Döring. According to the researches of Ameghino, the younger Tertiary deposits of South America show a remarkable peculiarity. This paleontologist discovered the remains of human beings not only in the Pliocene, but also in the Miocene, deposits. I must confess that, comparing the European Mesozoic strata with those of South America, quite another classification of the latter seems to be indicated. What has been called the Pampean formation in the Argen-

tine Republic, and referred to the Pliocene, is no other than the Loess in Europe, whose formation took place between the two latest glaciations. Adopting this view of the case, the so-called Miocene strata probably belong to the great ice period, and the Pehuelche stratum represents only the morainic deposits of the last ice period. The Plistocene deposits of South America are not yet studied in detail, but the glacial deposits I met in South Patagonia can be easily distinguished into two different groups: those of a former more extended and overarched formation, covering not only the lower parts, but also the table mountains of over 100 m. in height; and the younger formation, the kettle moraines of which are found along the foot of the Cordillera. The extension of true glacial deposits within the Cordillera seems to be much greater than generally admitted. Twenty years ago Raimondi described clearly true moraines from the Cordillera Nev. of Ancachs (about 9° s. lat.), reaching down to 2500 m. above the sea-level. I myself found moraine deposits in the Cordillera of Copiapo (28° s. lat.), about 1200 m. above the sea-level, and these observations coincide quite well with those made north of the equator by Sievers, who found the traces of former glaciation in the Sierra Nevada do Santa Marka and in the Sierra Nevada do Tarija. These facts seem to prove that the glacial periods did not alternate on both hemispheres, but that they were contemporaneous. In this respect further studies upon the Plistocene formations of the Cordillera of South America will be of great scientific value.

Besides the true glacial deposits and the æolean formation of Loess and loam, there exist in South America, especially on the High Plateau of Bolivia, like deposits of great extent. Terraces and tufa deposits analogous to those of the Great Basin of the West indicate a formerly much wider extension of the Lake Titicaca over the whole High Plateau from Southern Peru to the Argentine frontier. It seems that this former extension of lakes in South America coincides also with that of the lakes of the Great Basin region.

NOTES ON THE HEARTS OF CERTAIN MAMMALS.

BY IDA H. HYDE.

IN preparing a thesis for the degree of bachelor of science at Cornell University, in the spring of 1891, certain facts were observed and conclusions reached which have been thought worthy of presentation, if only as an evidence that further investigation is needed.

Professor Wilder placed at my disposal the following materials: Many hearts of the sheep and domestic cat, several human hearts, and the hearts of a monkey, panther, raccoon, hyena, dog, deer, calf, horse, donkey, and rabbit.

Special attention was given to the following parts: The Tuberculum Loweri, Eustachian valve, Thebesian valve, coronary sinus, and the oblique vein of Marshall, a few of the facts that seem of chief importance I shall state in the briefest possible manner.

The Tuberculum Loweri.—According to "Wilder and Gage's Anatomical Technology," "the distinct presence of the Tuberculum Loweri and the Eustachian valve have as yet not been determined in the cat." Nevertheless, I found what I consider the homologue of the Tuberculum Loweri of the human heart present in every heart examined. Although Hyrtl denies its presence in the human heart, all other authorities agree that it is a constant feature of it.

The Eustachian Valve.—Of the hearts examined, the Eustachian valve was found only in man, monkey, and a remnant of it in the cat, but not extending above (cephalad) the coronary sinus orifice as in man and monkey, but below it (caudad) and protects it. In the fœtus of the cat it is of relatively as great in extent as in man, but in the adult cat only a valve guarding the coronary sinus orifice remains. It is this valve that has been mistaken for the Thebesian valve by several anatomists.

The Thebesian Valve.—The statements concerning the Vieussens and Thebesian valves are perplexing. Allen and Gegenbaur say

"the Thebesian valve covers the opening of the coronary vein," whereas that valve over the orifice of the coronary vein is known as Vieussens valve, in honor of its discoverer. According to Heath, "the coronary valve guards the opening of the coronary sinus." But Thebesius was the first to make known the form and position of the valve over the termination of the sinus, and in his honor it is called the Thebesian valve.

According to Marshall, "the Thebesian valve is present in every instance in which the coronary sinus receives blood from the heart alone, as in man, monkey, dog, and cat, but absent in those animals that have a left azygos or left precava." Since the Thebesian valve was found only in man, monkey, and rabbit, and not in the cat, panther, and dog, where Marshall says it ought to exist, and one is present in the rabbit, where he says it ought not to be, this generalization will not hold good. A valve existed over the orifice of the middle cardiac vein in every heart examined, and as it is not named in any work as far as I know, I would suggest that it be called *coronary valve.*

The Coronary Sinus.—Morrell says "the coronary sinus of the sheep is the lower dilated part of the left azygos." Marshall holds that in those animals in which a left azygos or left precava exists it empties directly into the right auricle, and the coronary vein opens into it.

Bourgery, Owen, Gegenbaur, and Howell think the coronary sinus is but the dilated part of the coronary vein.

Personal observation causes me to differ from the above-named authors as to the homologue of the sinus. It is my opinion that the coronary sinus is the persistent primitive left Ductus Cuvieri, and that the left precava or left azygos, when they exist as as well as the great coronary vein empty into it; thus sending their blood through it to the heart. The great coronary vein empties into the sinus, and not in one case into an azygos, in another into a cava, again directly in the auricle. In support of this, Bardeleben says "the left azygos as well as the left precava, when present, empty into the sinus. That piece of vein under discussion is the left Ductus Cuvieri, which does not disappear in any mamaml."

The Oblique Vein of Marshall.—It was surprising to find that

the oblique vein of Marshall, which cccupies the place below the pericardium that the left precava does when present, is not shown in the illustrations or mentioned in the works of Owen, Wiedersheim, Howell, or Wilder and Gage's Technology. Not sending branches into the substance of the heart, it is not, as older anatomists thought, a branch of the great coronary vein. Although said to be improvided with a valve, I found one over its orifice in the heart of the monkey (*Cercocebus fuliginosus*). Marshall holds that the oblique vein of Marshall is the remnant of the left azygos of the fœtus. Since those animals that have the oblique vein of Marshall shall have also the termination of the azygos emptying into the left brachio-cephalic, I cannot agree with Marshall in this respect. The embryo heart shows the oblique vein to be the terminal portion of the primitive left precava.

VIVISECTION.

BY FREDERICK GAERTNER.[1]

IN this essay I propose to examine the question whether vivisection should be permitted in the interest of humanity and and science; and if so, with what restrictions.

Vivisection is the term employed for designating the operation performed with the knife upon living animals. This term, although including operations upon the human being, is applied principally to those performed upon the lower animals, such as the cat, dog, rabbit, guinea pig, etc., even frogs and fishes.

The performing of a surgical operation upon a human being, whether under the influence of anæsthetic or in a comatose or hypnotic condition, is simply one kind of vivisection. Now why should vivisection of the lower animals be prohibited when the same operation is performed upon human beings every day?

What are the objects of vivisection? I answer: first, the increasing of our knowledge of physiology; second, the confirmation of facts previously known; third, the acquisition of dexterity in operative surgery; and fourth, the experimental application of inoculative medicine, including vaccination and preventive and curative inoculation.

Without this process commonly called vivisection the sciences of medicine, surgery, anatomy, physiology, histology, embryology, and pathology would even yet be in their infancy, and in some respects at least would remain forever undeveloped.

Vivisection may be traced back as far as the years 377 and 460 B.C. Hippocrates, the greatest of ancient scientists, was a vivisector. Æsculapius, Celsus, Aulus, Cornelius, and later, Galenus Claudius, and other great ancient scientists, practiced vivisection upon the lower animals, and even upon human beings.

It is too well known to be disputed that Galenus Claudius (Galen), who lived from 131 to 201 A.D., was the first to discover that the arteries in the human body contained blood instead of

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air, as had been previously supposed. How else than by the process of vivisection could he have made this wonderful discovery?

Let me cite a few of the principal benefits that have accrued to physiology, and hence to the art of healing, by means of vivisection. By this course of procedure the doctrine of the circulation of the blood, the lymphatic circulation through the lymphatic vessels, and that of chyle through the lacteals, were established. Thus also our present knowledge of the nervous system and its functions is due to vivisection, since these facts could not have been obtained by the most minute anatomical research. Our present rational modes of treating epilepsy and the various forms of paralysis are due to the experiments of Brown-Sequard, Bernard, and others, upon the living animals.

The causes of the sounds of the heart would never have been understood without vivisectional experiments, and the stethoscope would have been useless in the diagnoses of cardiac diseases. The true nature of diabetes was thus discovered.

The Hunterian treatment of aneurism by ligature is the result of experiments upon the living animal.

The study and application of anæsthetics, one of the greatest boons to mankind, could be pursued only by experiments upon the living animal. Who would regret the suffocation of even greater numbers of animals when he considers the amount of agony and misery saved to man?

If there be a solution—and doubtless there is one—of such questions as the best method of restoring to life one apparently drowned, the restoration of one suffering from apparently fatal effects of chloroform, why chloroform kills, etc., who would regret the sacrifice of the animals necessary for these solutions?

What have been the results of vivisectional experiments during the last century? By means of vivisection the great French chemist and bacteriologist, Pasteur, discovered his wonderful preventive inoculative treatment of hydrophobia.

Dr. Austin Flint, Jr., proved that the liver is an excretory as well as a secretory organ. By comparing the blood drawn from the carotid arteries of a dog with that contained in the jugular

veins he has demonstrated that cholesterine—*i.e.*, the excretion of the liver—is the product of nerve action. Thus he was enabled to study that condition of blood poisoning which results from an abnormal accumulation of cholesterine in the vital fluid.

By means of vivisection we have been led to the present advanced state of knowledge in regard to the processes of digestion, assimilation, and nutrition.

Thus the Old World, leaning upon the staff of experience, is steadily advancing, climbing the lofty heights of science with a firm and certain tread. But we Americans, an enterprising nation, are sitting idly by, shackled by false ideas of humanity, while over our heads hangs an obscuring pall called the laws prohibiting vivisection.

Who are making the great scientific discoveries, the investigations and researches of to-day? Who are advancing every branch of medical and surgical science? Who are the great protectors of humanity? Answer, the vivisectors.

Science cannot advance without the aid of vivisection; therefore vivisection must and will be practiced, in spite of laws and governments. Then why not regulate and control the practice of vivisection, instead of prohibiting it?

Congress should be urged to pass a law making the art of vivisection part of the curriculum of every reputable medical college. Our government should assist and encourage scientific vivisectors in their researches and investigations, just as England, Germany, France, and Austria have done during the last century, by offering capital prizes and honorary medals to scientists, microscopists, and physiologists. Why not? All is in the interest of science, and principally for the protection of humanity against diseases.

But at the same time this process, this science of vivisection, should not be free to every meddler and dabbler in science. It should be practiced only by scientists, such as expert microscopists, physiologists, and pathologists. If an ordinary physician or other learned man wishes to practice vivisection for study or experimental purposes, let him be compelled to do so under the

supervision and instruction of a licensed vivisector at his laboratory, and under his personal observation.

Let Congress authorize the President of the United States to appoint a board of examiners for the purpose of examining applicants for the position of vivisector. Of course such applicants would be no other than expert scientists, microscopists, pathologists, and histologists. Let such a licensed vivisector be connected with every reputable medical college having a pathological and histological laboratory.

I am a strong advocate of anticruelty societies, but at the same time I believe that man has the first claim upon humanity. If the suffering of mankind can be alleviated, is it not cruel to refuse relief?

If the practice of vivisection is properly regulated the suffering of the animal can be greatly diminished. Let the work be done scientifically, with dexterity, ingenuity, and skill, and whenever it is possible let the animal be placed under the influence of an anæsthetic, chloroform or ether.

I have had the opportunity of studying the process of vivisection and its results, during my sojourn in Europe, at Virchow's laboratory, Berlin, Rokitansky's laboratory, Vienna, Pasteur's laboratory, Paris, and the Von Recklinghausen laboratory, Strassburg, and I have witnessed several thousand vivisections, and in each and every instance I came to the conclusion that vivisection is a necessary procedure, and of paramount importance in the study of medicine and surgery, their kindred and contributing branches. It is simply impossible to obtain a practical knowledge of physiology, histology, etc., without vivisection.

To prove that my assertions are correct, and based upon scientific principles, I will narrate a few practical cases in medicine and surgery in which by no other means than vivisection were the scientists able to demonstrate to the medical profession of the whole world that a certain medicine, or a certain described surgical operation, is necessary to save the patient and insure a speedy and complete cure.

Let us consider, first, *surgery*. The various surgical operations and procedures, especially as to their technique, have been

developed and perfected by means of vivisection. Consider particularly the abdominal operations, such as those performed upon the stomach, intestines, liver, spleen, kidneys, etc. The honor of perfecting these operations is due principally to Prof. Billroth, of Vienna, Austria, the boldest surgeon that ever lived. He, in the year 1879, performed for the first time that operation known as gastrotomy, upon a living human being (a woman). This operation consisted of a resection of the pyloric end of the stomach for cancer of the stomach. A complete recovery resulted. (An excision of a portion of the stomach was made, and the intestine was sewed to the stomach.) Of course the original idea was developed by means of vivisection.

Previous to this adventure Prof. Billroth and his assistant, Dr. Woelfler, had performed this operation upon ten living dogs. This was done in order to determine positively, first, whether or not this bold surgical operation was possible and justifiable; second, the best mode and technique of this surgical procedure; third, the rate of mortality; and fourth, the applicability of operative surgery in the treatment of such grave afflictions.

In all the various surgical operations upon the intestines there arose questions in regard to the technique, and principally as to the best application of stitches, sutures, instruments, antiseptic dressing, etc., as to the form, quality, and quantity applied. All these questions and difficulties were answered and overcome by experiments upon living dogs and cats. Excisions of the spleen, of one kidney, and of a part of the liver, were tried time and again upon living animals long before the operations were performed upon human beings with good results.

The various plastic surgical operations, operations upon the muscles, nerves, and bones, operations upon the eye, ear, nose, and throat, were first developed and perfected by vivisectional experiments upon animals.

Some of the more delicate surgical operations, such as castration, oöphorectomy, ovariotomy, etc., were first thoroughly studied and then applied in operative surgery after repeated experiments upon living animals. These experiments and proofs have justified

the surgeons in such bold surgical operations for the relief and permanent cure of such dreadful pathological disorders.

Since the term vivisection includes all experiments upon the living animal, whether the knife is used or not, there is also a medical phase of the question, and here it will suffice to say that the physiological action of all medicinal preparations would never have been thoroughly understood had it not been for experiments upon living animals. These experiments serve to determine, first, the physiological action of a drug or preparation; second, the minimum and maximum dosage; third, the poisonous effects of drugs, and their antidotes; and 4th, the effects of hypodermic injections and inoculations.

To an unbiased thinker I believe I have proved that vivisection is both necessary and justifiable. Even the humanitarian, if he be a sportsman, thinks little of the pain given to animals in the chase. No one objects to the killing of animals for food or for their commercial value, even though the animal die a lingering and painful death. If it is legitimate to slay animals in order to supply food and luxuries, and even amusement, why should it not be legitimate to inflict pain upon or to slay an animal for the higher and nobler purpose of relieving suffering humanity and prolonging human life?

Therefore, again I say, remove the prohibition, but regulate and encourage the practice of the indispensable accessory of scientific progress,—*vivisection.*

AMONG THE PREHISTORIC MONUMENTS OF BRITTANY.[1]

BY ALPHEUS S. PACKARD.

NOT far from the Land's End of France, and adjoining the picturesque coast of Finisterre, a favorite resort not only of French, but also of English and American artists, lie the barren and almost treeless plains of Morbihan, one of the eighty-six departments into which the French Republic is now divided. Morbihan is Celtic for "The Little Sea," and the district is famous not for its scenery, for the landscape is very tame, but for its impressive and mysterious so-called Celtic or Druidical ruins. These remains are mounds, tombs, and monoliths erected by a race whose remote descendants still occupy the soil, their farms and dwellings and hamlets bordering upon, and in part inclosing, the tombs and lines of stone pillars which keep silent watch over the region. The most imposing and best known of these series of pillars or "menhirs" are the great "alignments" of Carnac, which have for centuries excited the curiosity and interest of travelers and antiquarians.

Such monuments, if they ever existed in so great perfection in other parts of France, have been removed by farmers in clearing their lands, or in building their own dwellings, as with us glacial boulders have been removed and used for building stone walls. On the remote coast of Morbihan, however, where the land is comparatively sterile and treeless, and the population is sparse, not only have the monuments been tolerably well preserved, but the Bretons themselves, perhaps speaking a language derived from their pre-Celtic ancestors of the later stone and early bronze age, have preserved in a degree the probable features, the folk-lore, and some of the customs of the times when these monuments were erected.

Hence a journey to Morbihan, with its weird, somber landscape, its cider-drinking, superstitious, Celt-speaking peasants,

[1] From the New York *Independent*.

clad in their sober black garments, environed by the many mounds, tombs and standing stones, rising as silent witnesses of the mysterious past, and becoming an integral part of the every-day life of the inhabitants,—a journey among such scenes has a strange fascination.

From Paris to Carnac seemed like a journey to Ultima Thule. Ordinary maps in guide-books, and the books themselves, threw little light on this obscure corner of France. Had it not been for valuable information kindly afforded us by Prof. Gabriel de Mortillet, the distinguished founder of the prehistoric section of the vast Museum of National Antiquities at St. Germain-en Laye, who drew a rough map of the Carnac region, together with information given us by Dr. Topinard, the learned successor to the chair of anthropology formerly held by Paul Broca, who freely gave us his personal cards for use among the local antiquarians of Morbihan, we should have lost much time in seeking the most interesting places to visit. We were also indebted for useful suggestions to Mr. Thomas Wilson, who spent part of a previous summer in and about Carnac, and has, in company with M. Gaillard, the chief antiquarian of Morbihan, explored a number of dolmens, and whose article in the AMERICAN NATURALIST for July, 1888, was of much aid. Acting on such good and reliable advice, I made M. Gaillard's hotel at Plouharnel my headquarters, and from there made excursions to Lockmariaquer, to Carnac, to Erdeven, and to the Peninsula of Quiberon, thus seeing all the alignments and many of the typical tumuli and dolmens of Morbihan.

A journey in any direction from Paris through Brittany to the Atlantic coast is a delightful one. It was the middle of August, delightfully cool, often misty, to be sure, but with no pouring rain, and often a bright sun,—ideal weather for walking and driving in village carts. Leaving the Mount Parnasse station at eleven in the forenoon, the train shot by Versailles, with its palace, gardens, and surrounding forests, and after taking us through Chartres and Le Mans, left us early in the evening at Rennes, where we slept. Early the next morning we visited the museum of the university, and though it was closed,—it being a

fête day,—the keeper politely gave us a short hour of his time to enable us to see the pre-Celtic and other prehistoric remains of stone, bronze, and iron. Here are amassed the rich vertebrate remains, including the bones of the mammoth from Mont Dol, Brittany, associated with human flint implements, many polished stone axes taken from dolmens; but of especial value are the fine Gallo-Roman remains and the many relics of the Merovingian age excavated from the Necropolis of Caranda. Among the many fine objects in the geological museum of interest to the anthropologist is an immense mass of jade from New Caledonia, perhaps a foot square. Merely glancing at the valuable zoological and art collections gracing the halls of a lyceum in a French provincial city of 60,000 inhabitants, and heaving a sigh at the utter lack of local museums and art collections in far wealthier provincial cities in the United States, we hurried to the station and took the train for Vannes. The afternoon was spent at this strikingly picturesque town, with its ancient timbered houses, leaning over toward each other across the narrow streets in such a social mood; with its mediæval walls and towers, its three notable gateways, its Norman cathedral, and lovely park and flower gardens. It was the *fête* day of the Virgin, and a procession of men and boys, with women and girls in their white-starched caps, such as perhaps only gather in unique Brittany, filled the square and moved slowly down the incline, closing its ranks as it approached the most ancient of the city gates, the Porte Prison, situated between two machicolated towers rising from the town walls.

One should visit the excellent museum here before passing on to Carnac. The Musée Archéologique is situated in the third story of a very old, rambling, timbered building, with creaking oak stairs and ghostly corridors. The rooms are small, but the cases contains very rich collections taken from the dolmens and tumuli we were afterward to visit. Here were placed together in the case the relics excavated in 1862 from Mont St. Michel, at Carnac, the largest burial mound in France. It comprises superb series of polished axes in jadeite, chloromelanite, fibrolite, and diorite, with a beautiful necklace of green turquoise. There was

also a fine series from the tumulus of Mané-er-H'roëk at Lockmariaquer, comprising besides six jadeite axes ninety-two of fibrolite, which is a dark variety of serpentine. The pottery of the mound was represented, and among them were seen the rude, unfinished earthenware, precursors of our bowls, tumblers, and cups and saucers. Some of the "green turquoise" heads were cylindrical, perforated, and exactly resembled in shape and color a jade bead we had obtained at Cholula, from a Mexican Indian. The jadeite implements were illustrated by unworked specimens of jade from Thibet, and of jade nephite from Siberia, as well as saussurite from the valley of the Saas.

Reluctantly leaving this quaint and attractive town, we took the evening train for Plouharnel Carnac, reaching the Hotel du Commerce, kept by the two daughters of M. Félix Gaillard, to whom we took a card of introduction from Professor Topinard, and from whom we received every kind of attention and aid, the learned archeologist freely giving us the benefit of his many years' exploration of neolithic menhirs and dolmens, as well as Gaulish burial-places. Part of the hotel is devoted to a very rich local museum, crowded with stone implements, ornaments, and articles in bronze and gold, pottery, including funeral lamps with holes for the wick, and three graves removed with their contents from Quiberon, the whole illustrated by stone implements from North America and New Caledonia, with objects from the Swiss palafitts, or pile dwellings, which M. Gaillard told us are of the same age as the dolmens of France.

And now, before we actually visit these strange memorials of past neolithic occupation, let us explain the meaning of the Celtic names applied to them. The megalithic monuments are rude monoliths of the granite of the Breton coast, called *menhirs*, from two Breton or Celtic words, *men*, a stone, and *hir*, long; they are also called *peulvans*. The menhirs are arranged in groups of from nine to thirteen rows, each row being called an alignment.

The tomb-like structures called dolmens are so named from *men*, a stone, and *dol*, table. They consist of a few large, broad, flat stones set up on edge so as to inclose a more or less oblong space; the larger ones are about six feet high, and covered over

by a single great slab (called table) or several flat stones. The smaller ones are said to resemble tables and altars. Many of those in the Morbihan are approached by covered galleries, which are generally straight, but at times curved; the main structure or chamber is sometimes wider than long. They, in nearly each case, face the east, and were places of sepulture or tombs, being the precursors of the old-fashioned tombs of our cemeteries, and were covered by mounds of earth called *tumuli*. A tumulus sometimes enclosed a cairn or *gilgal*, or heap of squarish stones, six or eight inches or a foot in diameter, thrown or laid over the dolmen to protect it from wild beasts. A *cromlech* in France is a circle or semicircle of menhirs or upright stones. The stones composing a cromlech are usually smaller than the majority of the menhirs, and the stones touch each other, while in an alignment of menhirs the individual stones are from two to several feet apart. The word cromlech is from *kroumm*, curved, and *lec'h*, meaning sacred, or, according to some writers, smaller stones.

There are in the single department of Morbihan 306 dolmens, and throughout France 3,410. They are rarer in the north and east than in central, southern, and western France. Beginning with the most eastern point at which dolmens occur, archeologists have observed them in western India, where they have been used to the present. They are found in Palestine, near the Dead Sea, in the land of the Moabites. Going west, we find them on the other side of the Caucasus Mountains, in Circassia and the Crimea. Passing farther to the westward, they occur in Central Europe, northeast of Dresden, from Mecklenburg through Denmark into southern Sweden, but none occur in Norway. Returning to Germany, many have been discovered in Hanover and the Low Country, as well as in Belgium, in Luxembourg, and Switzerland. They also occur on the Channel Islands, in Cornwall, in the Isle of Man and of Anglesea, some in western and a few in the eastern counties of England, while many occur in Scotland and in Ireland. Turning to the Mediterranean region, there are the ruins of dolmens in Corsica, in northern Spain, in Andalusia, in Portugal, while in northern Africa they are abundant from Morocco to Tripolí, especially in Algeria. Mortillet rejects the

theory once held that the dolmens were constructed by a migratory people, maintaining that they were the work of a sedentary population, and not of one and the same race, as skeletons of very different races have been found in them. At the same time many facts tend to show that the dolmen-builders in the first place came from the east. Mortillet also states that dolmens were burial chambers used as places of sepulture by families or by tribes. The menhirs were also quarried and erected by the designers and builders of the dolmens, who roughly hewed and chipped the monoliths into their present shapes with small axes of polished flint, jade, and the harder varieties of serpentine.

Before we inquire into the traits and customs of the Neolithic tribes, let us glance at the monuments they left behind them.

After breakfast we clambered into a Breton village cart, driven by a youthful latter-day Celt, with M. Gaillard as our courteous guide, and set out over an excellent road, often bordered with the broom and hedged with gorse, past farms and scattered dwellings of stone, through the village of Carnac, with distant views of the Atlantic, dotted with the brown sails of the sardine fishing boats, and on our left overlooked by the tumulus of San Michel, the highest elevation in the neighborhood. The road soon passes over a causeway bordered with salt vats; and after an hour's drive we cross the ferry a little above the fishing village of La Trinité. The ferry, by the way, was an interesting study. Although the amount of travel on this road would hardly seem to warrant it, the road on each side of the arm of the sea was elaborately paved with granite blocks to a point below low-water mark. The boat was a big scow, large enough to hold two carriages, and was slowly, laboriously pulled across by means of a large iron chain.

At the village of Lockmariaquer, which was the site of Dariorigum, or of some other Roman settlement, we walk out to the end of the solid granite jetty, whose earliest foundations are attributed to the celts, the Romans afterwards improving upon them. We engage two fishermen to take us in their boats to Gaverne or Gavr'Inis, *anglice* Goat Island, on which is perhaps the most interesting tumulus and best-preserved sculptured dolmen

in the Morbihan, and probably in Europe. With a fair westerly wind and a bright sky we hie on, taking the opportunity to eat our lunch of cold meat, bread, and cider, with a course of excellent, though tiny, raw oysters, which are usually offered at the hotels throughout the coast towns of Brittany. Clambering ashore over the slippery rocks we walk up a lane bordered with fig trees, and ascend the eastern side of the mound, which is a *galgal*, or cairn, twenty-six feet high, and covered with soil overgrown with the broom and prickly gorse.

The view from the summit of the mound, over the Gulf of Morbihan and its shores, is one of much interest, from the fact that some of the distant eminences are artificial mounds, and that on some of the islands there are dolmens. We can look across a narrow passage swept by swift tidal currents to the little ragged island of Er-Lanec, with the remnants of one cromlech, half of the circle on the shore and the other half below high-water mark, while beyond, at low water, can be seen the prostrate stones which once formed a second cromlech. The land has fallen, and the sea has partly torn down this and all the other islands since the times when the dolmen builders inhabited this region.

Descending, we enter the gallery of the dolmen by a path walled in with the square porphyritic granite blocks taken from the sides of the galgal, and, passing through the low, narrow gallery about twenty-five feet long (Cartailhac says thirteen meters) we enter the chamber, which runs east and west. About forty huge slabs form the pavement, the walls, and the ceiling. One of the slabs in the ceiling is of quartz; and we judged the largest slab to be about eighteen feet square. But the distinguishing feature of this dolmen is the mysterious sculpturing on the slabs. All the granite wall-slabs are thus sculptured, the marks being cut in. And what was the nature of the tools? The quartz slabs alone had been untouched. Cartailhac argues, with good reason, we think, that the implements could not have been of iron, as only the softer granite was grooved and engraved, and that the engravings were made with stone tools. It is also noticeable that in other dolmens we visited, symbolic stone axes, mounted on handles, are engraved on the slabs of the ceiling, while on a

single upright slab in the dolmen we are now describing there are eighteen such axes figured, with others in the same gallery.

The marks themselves roughly resemble the tattoo marks of Pacific Islanders. As Cartailhac remarks in his "La France Préhistorique" (1889), they are diverse linear combinations, being straight, curved, waved lines, either isolated or parallel or ramified like fern leaves, or arranged in segments of concentric circles, either limited or not, and trimming certain compartments of spirals with short turns, recalling exactly the figures made by the wrinkles of the skin on the palms of the hands and the finger-tips.

The last-described marks are certainly the most typical and abundant, and perhaps were suggested to the proto-Celtic engraver by studying the lines on his hands. The artist was not hurried in his work, and, as Cartailhac says, the sculptures must have been made before the stones were put in place.

But the tide is going out, and we must unwillingly leave this fascinating ruin and return to Lockmariaquer, to visit other dolmens. One of the most notable, situated south of the town near the base of an elliptical mound, thirty-nine feet high, is the dolmen Mané-er-H'roeck (the mountain of the fairy). The opening to the gallery, as in all the other dolmens, faces to the east; and to enter it we pass by two enormous but prostrate menhirs, one thirty-one and the other twenty-five feet long. The walls of the dolmen are built in horizontal layers, and one of the stones raised on the right side of the entrance is ornamented with very beautiful and curious sculptures, some like escutcheons, besides ten figures of symbolic axes with handles. Thence walking across a potato field, occasionally stopping to pick up fragments of Roman tiles, we approach the "king of the menhirs," called Mane-ar-Groac'h. His monolithic majesty is second in size and height to none in Europe, or any other country; the next largest one in Brittany being thirty-seven feet high. It lay however, prostrate, and broken into four pieces. When entire it was sixty-seven feet six inches long, seven feet six inches thick in one diameter, and thirteen feet six inches in the broadest portion. This colossal menhir, as usual when one or two stand

alone, served as a monument, and was evidently in direct relation to the tumulus and the inclosed dolmen, for we noticed one standing sentinel over a dolmen; and they are sometimes erected on the summit of a tumulus, as at Ile de Sein; in such case they may have been put up to indicate burials. The dolmen near the base of the Mane-ar-Groac'h is a famous one, and, like many of the others, has been purchased and restored by the government. It is the Dol-ar-Marc'hadourien, or Table of the Merchants. On the under or inner side of the great table or covering slab, which is twenty feet long by thirteen feet wide, was engraved a large stone symbolic hatchet with its handle. That these images are in reality rude representations of hatchets seems plausible. Stone axes, apparently made expressly for ceremonial use, are found in nearly all dolmens, having been placed there by the side of the dead; and they are in nearly all cases beautifully finished, with sharp, unbroken edges, and often of jade, which is only now to be found in Asia and Polynesia, being one of the rarest minerals in Europe, Some authors suppose that the axe was regarded by the people as the symbol of separation, an emblem of the end of life. However this may be, whether from its utility alone in every-day life, or its use as a weapon of war, it must have been a highly prized and venerated instrument, to be so often engraved on tombs, and so invariably buried with the dead.

This region is especially rich in dolmens, as they are scattered all about Lockmariaquer; the dolmen of Mane Lud being situated on one of the principal streets, next to a house, the tumulus once inclosing it rising behind.

A little way out from the town is the dolmen of Kervress, remarkable for the cup-shaped pits in the under side of the covering slab, and which, of course, must have been made before the stone was put in place. These cup-shaped hollows are scattered irregularly over the surface, varying somewhat in size, the largest being about an inch and a half in diameter. They are a great puzzle to archeologists, who can make nothing of them. Occurring in Germany, Switzerland, among the Alps and the Pyrenees, and in Portugal, both in dolmens and on menhirs, they had some meaning to the men of the stone and of the bronze

PLATE XIX.

ALIGNMENT OF MENEC.

age, after which they ceased to be formed. It is only to be said, with Cartailhac, that at the present day Hindu women at the approach of maternity may be seen carrying water from the Ganges, with which they sprinkle these symbolic cups in their temples with prayers to the divinity indwelling.

Such superstitions still prevail, unless they are of new and independent growth, in France, and in the Pyrenees, in Sweden, as well as in Switzerland, where they are either regarded as the work of elves, or visited by young girls and widows in the hope of getting husbands. The great mound of St. Michel looms up as on our return we approach the little village of Carnac. It is the largest tumulus in France, overlooking the rather flat surrounding country and the Atlantic, with Belle Isle in the distance and to the right the peninsula of Quiberon. The tumulus is now 65 feet above the surrounding fields, though originally it must have been considerably higher, its summit having been leveled by the Romans, who built a temple upon it, while the remains of a Gallo-Roman villa are still visible near its base. In place of the Roman temple stands a humble and not at all interesting chapel, dedicated to St. Michael. We ascend the tumulus by the fifty-two steps made of the small granite blocks taken from the galgal which protected the dolmen, the great elliptical mound of earth covering both dolmen and cairn, being 400 by 200 feet in its greater and lesser diameters. Toward the north and northwest are plainly to be seen the famous alignments of Kerlescan, Kermario, and Ménec, which we were to visit on the morrow, when M. Gaillard was again our guide, philosopher, and friend. Without his intimate knowledge of these striking monuments we should not have half seen or understood them, and the kindly man, full of enthusiasm and enlightened interest, told us all he knew of the alignments and their probable object. His conclusions seem to us to be in advance of what has been published by the leading French archeologists, who have only made comparatively brief visits to the region. Fortunately the government has for a number of years taken possession of the alignments and most of the dolmens, restoring them by setting the buried or fallen

stones into their original places, so that we saw them under more favorable auspices than earlier travelers.

With our old white Breton horse and ricketty cart, and youthful Breton presiding over the reins, we again drove through Carnac, past Mont Saint Michel, and turning sharply north at the salt vats, drove through a delightful lane shaded by chestnuts and oaks, with walls of turf overgrown by the gorse, leading to an old chateau, buried from sight by a thick wood. It was just the day for exploring alignments. The same blessed sun which for so many ages had shown upon these same stones while being planted by throngs of Neolithic workmen, perhaps under the inspiration of their priestly leaders,—the same sun shone brightly under the menhirs rising from the gay purple heather which clothed the undulating plain. M. Gaillard had wisely conducted us to the easternmost point, and was now to lead us for three or four miles westward, so that we could review, one after the other, beginning with the thirteen alignments of Kerlescan, and ending with those of Ménec.

There are at Kerlescan thirteen rows or alignments, comprising 262 menhirs, and extending westward about 1,000 feet. At the western end is a cromlech now restored, which, instead of being semi-circular, is somewhat square, inclosing a space about three hundred feet in diameter. We then visited the interesting elliptical mound inclosing the dolmen of Kerlescan, lying just north of the middle of the group of menhirs, which is exceptional and indeed unique in Brittany from having been surrounded by an elliptical cromlech or circle of menhirs, some of which were six or seven feet high, and placed a few feet apart, not touching each other as in those of the alignment. Then retracing our steps, picking our way back through masses of the prickly, forbidding gorse, which bore an occasional yellow pea-like flower, we examined the cromlech, and, taking to our cart, drove on to the next series of alignments, the larger one of Kermario.

The avenues of Kermario consist of 855 menhirs planted in ten rows, extending over the undulating heath for nearly a mile, or, to be exact, 4,037 feet. The standing stones are impressive for their size and height, some of them being twelve feet high.

Moreover, an added interest are the traces of Roman occupation on the south side near the western end,—in fact, traces of the civilization of Rome of the period of the Gallic wars are scattered over Morbihan; and the peasants call the alignments Cæsar's Camp. Indeed their explanation of these lines is that their patron Saint Corneille was pursued by the Roman army, which was, as a punishment, turned to stone, the taller pillars representing the officers.

After crossing another interval we reach the eastern end of the alignment of Ménec, whose cromlech, at its western end, incloses some of the farmhouses of the hamlet of Ménec, which is not far from Carnac. The menhirs lie to the north of the road between Carnac and Plouharnel. The group is a little shorter than that of Kermario, being 3,376 feet long, and consists of eleven instead of ten lines, and the stones are not quite so high and imposing as those of the middle group. The stones or pillars vary much in shape; some are much rounded; many were, however, planted with the smaller end down; and whether it is a mere coincidence or not the highest stone is about eleven feet high, the number of rows is eleven, the alignments themselves are about eleven yards apart, while the spaces between the stones composing each line are often ten or eleven feet apart. In this, as in the other groups of alignments, the rows are not mathematically straight, but more or less wavy, and the stones vary much in distance apart, all the way from perhaps three or four to ten or eleven feet. In general the stones decrease in height toward the end, where they are not much over four or five feet high. The groups follow the natural inequalities of the plain, whose surface is rolling, the country slightly descending from Ménec to Kerlescan.

The semi-circle of stone or cromlech at the western end of the Ménec group was inclosed by standing stones from about five to six and even eight feet high, which touched each other. At present many are prostrate, and there are two or three small stone farmhouses within the circle. Fortunately the government purchased the entire group in 1888, and will raise and plant the fallen stones; and as the inhabitants of the houses die or remove, the buildings will be taken down. The restoration of the Kermario

group is nearly accomplished, and is almost entirely inclosed by a low stone wall.

It was hard to leave this weird, fascinating, and impressive landscape, in which the natural features were tame enough, the strange interest being due entirely to the work of the heads and hands of a forgotten and extinct people, who have passed away leaving not a tradition behind them,—only these imposing monuments of stone.

> "No priestly stern procession now
> Streams through their row of pillars old;
> No victims bleed, no Druids bow,—
> Sheep make the daisied isles their fold."

Returning to our hotel to breakfast, we spent the afternoon in exploring the dolmens and alignments of the Quiberon peninsula, accompanied by M. Gaillard, who was so enthusiastic and interested in having us see everything of archeological interest.

The carriage road to St. Pierre, which is a little village situated on the new railway running to Quiberon, passes over a dreary, monotonous waste of sand, and as it runs along the middle of the neck of land reveals few extended views of the ocean. On our way we pass on the western shore, not far from the site of a Gaulish burial-place, from which M. Gaillard had recently exhumed seven skeletons, with bronze bracelets and Gaulish coins and pottery. After visiting the dolmens and tumuli of Port Blanc, on the west shore near St. Pierre, gathering pieces of pottery, bones, and flint chips, and seeing how the ocean has encroached on the slowly subsiding coast, so as to undermine the cliff and the tumulus, which must have been situated much farther inland in pre-Celtic times, we walked over the grassy, sandy wastes back to our cart, and drove past the village of Saint Pierre and its old windmill to the menhirs and cromlech on the shore. How long the rows of standing stones were originally, it is difficult to say, because the coast has sunken and the waves have undermined and overturned the stones at the eastern end. Walking down across the field, where the men, and women, too, were digging potatoes, we stood on the edge of the *falaise*, or sandy cliff, and the tide

being partly out, we could trace some of the lines into the sea. A few of the stones were lying prostrate on the beach, while others beyond were overgrown with sea-weed, and still beyond lay some under the waves. There are in all five lines, which extend in a southeasterly direction for 635 feet seaward. At a distance of about ninety yards from the head stones of the rows, the highest menhirs being about eleven feet, is situated the ruined cromlech which, according to Lukis, was two hundred feet in diameter. We did not attempt to measure it. The group has not yet been restored, and only about a dozen of the stones are still upright.

M. Gaillard had brought his compass with him, and now demonstrated a curious fact to us. He had already called our attention, while visiting the alignments of Kermario and of Ménec, to the occurrence between certain of the rows of a single menhir, standing by itself, and which has been overlooked, he said, by all other archeologists. In the alignments of Kerdescan this mysterious odd stone is situated, we think, between the seventh or eighth space between the rows. It is about eleven feet high, and from nine to ten feet thick at its greatest diameter, which is not far from the top, the stone being smaller at its base. In the alignments of Ménec the single menhir is in the third space from the northern side; namely, between the third and fourth rows of planted stones. In each group of alignments, at least in four of them, this odd menhir occurs, though varying in situation, depending apparently on the position of the rows, none of which are exactly in an east and west course, as their builders had no compass. They are all situated not many paces—perhaps fifty, more or less—from the cromlech.

Now our friend and guide took the greatest interest and satisfaction in placing his compass on one of the middle stones of the cromlech at St. Pierre, and demonstrating to us that the line of 50° (it varies from 45° to 50° in different groups of alignments) intersects the single menhir. M. Gaillard has been here, as well as at the other alignments, at sunrise on the morning of the longest day in the year, the 21st of June, has placed his compass on this menhir, and at the moment the sun appeared above the horizon the odd or single unaligned menhir was seen to be in line with

the median stone of the cromlech and with the sun. It is therefore inferred, and very naturally, that the designers and builders planted these stones in accordance with a fixed plan, and that the inclosure must have been the scene of some ceremony at the time of the summer solstice. And this confirms the idea insisted on by archeologists, among them MM. Cartailhac and Gaillard, that the groups of standing pillars were planted after a common design and nearly at the same epoch, and that the people who erected them were possibly worshipers of the sun, having brought with them from the far east, their original home, the cult so characteristic of eastern races. On the morning of our last day spent in the Morbihan—and what soul-stirring and awe-inspiring days they were, with the charm of the fresh Atlantic breezes, and the bright sun lighting up the heaths and plains, the quaint costumes and dialect of the peasants lending an unusual human interest to the scene—we drove to the dolmens and alignments of Erdeven, through a region of lilliputian farms. The property of the country people is chiefly in land, and the farms handed down from one generation to another becoming gradually halved and quartered, though many were triangular or polygonal in shape, until some of them seem scarcely large enough to support a sheep or cow, or to afford room enough for even a small potato patch. Moreover, they are hedged in by high turf walls overgrown with gorse, one of the most forbidding of prickly plants. Some of the farms were inclosed in turf fences, perhaps four or five feet high, with the corners elaborately built of stone.

The largest of the dolmens in Brittany is that of Crucuno, called *La Roche aux Fées*, or the Stone of the Fairies. A farmer had built his house next to it, and the dolmen, by no means of fairy-like proportions, was used as a cow-house until its purchase and restoration by the government. It is twenty-four feet long by twelve wide, and one can stand upright in it. From this impressive dolmen a path, which a boy will point out for a slight cupreous gratification, leads across the fields to the very remarkable dolmen of Mané-Groh, which is galleried, and besides the principal chamber, has four lateral inclosures.

We shall now dismiss the dolmens, which are so numerous and interesting. They are regarded as the tombs or burial-places, possibly in some cases ossuaries, of tribal chiefs and their families. They were opened at intervals, perhaps for the interment of the successors of the warriors for whom they were first built. Many of them have a circular hole in the stone door a little over a foot in diameter, too small for the passage of a body, and probably used for the deposit of food for the service of the departed in his wanderings in the other world. It is not improbable that our pre-Celtic, neolithic ancestors brought with them from their eastern homes the observance of burial rites, and very primitive religious ideas, involving some notion of a future life, besides the worship of their ancestors and of the sun.

On the whole the Erdeven group of alignments is more impressive than the others, on account of the greater length of the rows, the larger, higher stones, and their greater number, 1,120 having been counted by M. Gaillard. They extend over the rolling plains a distance of more than two kilometers, or over a mile,—viz., 6,886 feet. One of the standing stones near the western end is nineteen-and-a-half feet in height, and two others a little over twenty feet high; one of the prostrate stones is called "the sacrificial stone," but the furrows in the surface seem due rather to weathering than to artificial means.

Could one stand at or near the head, and overlook the entire group of alignments, the impression made would be of course more striking than at present, since many of the stones have fallen, and the lines are much broken, while they make a turn to the southeast near their middle. But as they stand, the longer the observer lingers among them the more impressive they become; and not to see the alignments of Carnac and of Erdeven is to miss one of the wonders of the world. They rank in importance and interest with the ruins of Central America and of Mexico, and the so-called Pelasgic walls and burial-mounds of Greece, while they are by far the most imposing relics of prehistoric times.

Rows of standing stones are not, however, confined to the Morbihan; the menhir-erecting and dolmen-building race, judging

by the monuments it has left behind, existed in other parts of France and of the Old World. According to the latest and most trustworthy authority, M. Cartailhac, whose work entitled "La France Préhistorique" appeared in 1889, there are in Morbihan eight of these groups of alignments, including the cromlechs connected with them, and nine, far less important, in Finisterre, five in the department of Ille-et-Vilaine, and six or seven others, of small size and slight importance, in the rest of France, most of them only forming one or two short rows of standing stones. Mortillet says there are in France fifty-six alignments, in fifteen departments. Analogous to the alignments in France are the Sarsden Stones in Berkshire, England, which are composed of 800 menhirs.

Solitary standing stones or monoliths of a later age occur in the Pyrenees, in Corsica, and in Northern Africa, and at present the natives of Madagascar and the Khasias of Northwestern India raise stone columns around their tombs ; but these are analogous to the solitary menhirs planted near the dolmens, or those composing the cromlechs, surrounding dolmens, or tumuli. Whether of original prehistoric growth or a later development, the solitary menhirs are in Thibet and in other lands venerated as symbols of the reproductive powers of nature. Finally, we have the solitary obelisks of Egypt, and the monumental stones of mediæval times, which have survived to our day in the granite shafts and marble columns memorizing great national events, or sacred to the memory of the departed.

The alignments were not made spasmodically, at irregular intervals, one stone after another being set up during a long period, as in a modern cemetery, but they were evidently built at one period after a fixed design or pattern, to which all conform. Those of Morbihan and of Finisterre were undoubtedly planted at the same time by the same people,—a race animated by other ideas than those of living merely an animal existence. It is not probable that they were memorials of some conquest or other event of great importance. It seems natural to conclude that these vast and imposing relics, whether we consider the size of the stones themselves, their enormous number, their repetition

over a not very extensive region, and their similarity of plan and contemporaneity with the dolmens, were the outcome or tangible expression of the religious nature of the pre-Celtic mind. The people had, long before starting on their westward migration, emerged from savagery, and after centuries of physical and intellectual effort, having peopled Europe, now strong in numbers, and dominated by lofty conceptions and wonderful zeal and industry, had met together, and working, as if impelled by a common inspiration and impulse, under the direction of their priests, raised these unique monuments. The population must have been dense; it was not now migratory, but an agricultural as well as pastoral people. The materials for the dolmens and menhirs were not far off. No traces of quarries have survived, because the Atlantic, in conjunction with the plutonic forces at work in the earth's crust, has lowered the coast, and washed away all traces of these mighty workers in stone. As we noticed in the materials of some of the dolmens and menhirs, the rock is a porphyritic granite, with oblong crystals of feldspar and scales of black mica, readily rusting on exposure to the air. On the cliffs at the ferry, on the way to Lockmariaquer, we noticed the rock in place. It readily and naturally breaks by the action of frost into square or oblong blocks, fitted either for monoliths, or for the small, squarish blocks with which the galgals were formed.

More industrious and inventive than savages, they made use of their oxen, and, whole families or tribes coöperating, the busy multitudes, swarming like bees, with the use of stone axes and chisels, and the aid of fire, quarried the big slabs for the dolmens, and the monoliths for the alignments. They probably moved them on rollers a few hundred yards, or even one or several miles, inland, and then, with a skill developed by long experience, and probably after many a bitter failure, set the stones in place. Some of the menhirs stood on the surface, without any foundation; in other cases foundations for them were carefully laid. So long have they stood that all marks of quarrying have been effaced by the agency of the atmosphere. As Wilson states, a menhir in the headline of the Erdeven alignment, which had been overturned and used as a fireplace, though with tool-marks on it, and buried

during Roman occupation, must have remained prostrate from fifteen hundred to nineteen hundred years; "yet it had previously stood on end long enough a time for the top to become so weathered as to be plainly distinguishable from the bottom."

What, then, was the use of these remarkable monuments? No burials took place among them. The chiefs and their families were deposited at death in the dolmens. The question is still an open one, the best archeologists differing as to whether they were monuments to the dead, or whether they were temples. The common design pervading all the larger alignments, showing that they were erected at the same epoch, forbids one accepting the view that they were simply commemorative of different persons, that they were a kind of archive, each stone recalling a fact, a person, or a date. The remarkable care observed in burying the dead proves that these people were strongly religious. The care taken to put in the proper place the odd stone, and its relation in the summer solstice to the rising sun, indicate that the alignments were erected for the worship, on stated occasions, of the sun. M. Gaillard told us that he believed the menhirs were erected by this early race as monuments to their ancestors. The English archeologist, James Miln, who lived for many years at Carnac, and who founded and built the interesting local museum which bears his name, tells us in his "Fouilles Faites a Carnac" that after taking into account the association in this region of menhirs, of alignments, of cromlechs, and of dolmens, he concludes that "these monuments are the débris and the remains of an immense necropolis," and perhaps this is the more natural and logical view to hold. At the same time, while this involves the worship of their ancestors, the sun may also have shared in their adorations.

Judging by the contents of the dolmens, some bronze bracelets and other articles having been found in them, these megalithic monuments were erected during a period of transition from the stone age to the age of bronze; and they are supposed to be contemporaneous with the pile dwellings of the stone age of Switzerland. Who were these stone axemen, these neolithic stone masons, who could with their polished celts quarry, and could

transport monoliths weighing more than some of the obelisks of Egypt, the great menhir of Lockmariaquer being nearly 68 feet long, and weighing 240 tons? Were they genuine Celts? Prof. Gabriel de Mortillet says no. "All these primitive monuments formerly bore the collective name of Celtic or Druidical monuments. It was supposed that they were peculiar to the Celts, and raised by their priests, the Druids. It is a great error. These monuments are found in abundance in regions which have never been occupied by the Celts, as Denmark, Spain, Portugal, Morocco, Algeria, etc. They are even very probably in greater part anterior to the great Celtic invasions; and if they attracted the attention of the Druids, it was only when they were already partly in ruins and lying on the surface of the soil" ("La Préhistorique Antiquite de l'Homme," 1885).

Cartailhac, in his excellent work on Prehistoric France (1889), also says that we must abandòn the views of the older archeologists, who believed that these were Druidical monuments, and should be attributed to the Gallic or Celtic race, or to any single race of emigrants from the east. Within twenty years, owing to the rapid course of discovery in France, so many dolmens having been opened, in which were found the skeletons of different races, the tendency among the most experienced French students is, with Mortillet, to deny any special ethnic value to these monuments. For example, De Quatrefages discovered the bones of two races in the same dolmen, and Hamy has demonstrated that the population of France was almost as much mixed during neolithic times as to-day. Cartailhac concludes that the problem of the megalithic monuments is exactly that of the advanced civilization of Europe, which even in prehistoric times became almost universal, and which is called neolithic. "Did it," he asks, "reach our country with new races or populations? Was it spread by contact of one people with another? We have no response to make to these questions. The truth is probably scattered throughout all systems, and that which is true for one country will be inexact in another."

All archeologists, however, agree that these monuments were erected by the neolithic race or group of races, who used pol-

ished stone axes, and that this complex of races originated in the east, perhaps between the Caspian and Black Seas, migrated into Europe, bringing with them the cereals, flax, and the domestic animals and burial practices, and that they had religious ideas. As compared with the paleolithic races of the Old World, or those who were simply hunters and fishermen, and were of a purer, more savage, and primitive race, the neolithic peoples were a most composite type. To narrow down the problem, the French archeologists acknowledge that the megalithic monuments of France were of the same age as the pile-dwellings at Robenhausen, near Zurich, which are of the polished stone age. It is well known that the lake-dwellers of Switzerland, as the centuries went on, received from the east and south bronze implements, and a knowledge of the art of making bronze tools. It is also known that the dolmens of Northwestern France were still used as places of burial as late as the beginning of the bronze age. Hence it seems natural to infer that the people who built these monuments were the ancestors of the Celt-speaking Welsh, Irish, and Bretons. The Robenhausen civilization was not probably much older than that of Egypt; and it seems reasonable to suppose that the menhirs and dolmens of France were of recent age, compared with the troglodytes of Spy and Neanderthal, the cave-dwellers of Cro-Magnon, of Dordogne, and of Kent's Hole or the men of the Mentone rock-shelters.

At all events—and this is the great charm of such inquiries—the problem is as yet unsolved. We may wander up and down these alignments, so weird and awe-inspiring, and speculate as to what manner of men were their builders. Few places in the world are enveloped in such an atmosphere of myth and doubt. The very people now inhabiting these stone-studded plains, perhaps their remote descendants, speak a semi-fossil language, go about among these monuments of the dead in a funereal garb of black, still cherish a few pagan, almost prehistoric, superstitions. They can readily talk with Celtic, Irish, and Welsh, but French is a foreign language to them; and, in short, they are a link between the present and the age of stone. Many English travelers visit this strangely interesting region. Why is it that so few Americans care to wander to the Morbihan?

THE DOUBLE MONSTER ROSA-JOSEPHA BLAZEK.[1]

ROSA and Josepha Blazek were born January 20th, 1878, a Skreychov, in Bohemia. Their birth, which seems to have taken place without any difficulty, was accomplished under the care of a village nurse.

The mother, aged twenty-two years, had been delivered, two years previously, of a well-formed and healthy daughter. The parents are sturdy peasants, of some means, but of limited intelligence. Until recently they have been opposed to a public exhibition of their children.

A short notice printed at Prague in 1878 shows that six months after their birth they were visited by M. Auguste Breisky, then a professor of the German Faculty of Medicine ot that city, and director of the Gynecological Clinic. After an examination, M. Breisky stated that the development of Rosa-Josepha was in accordance with their age. M. Marcel Baudoin relates that soon after their birth the parents, horrified, took the advice of an old woman, and left them eight days without food, expecting them to die.

At first sight the sisters Rosa-Josepha give the impression of two little girls, rather small for their age (now thirteen years), very blonde, slightly pale, with a gentle, amiable manner, and eyes somewhat languid in expression. On seeing them sitting side by side on the same footstool one would hardly suspect their union when they are dressed; but if one makes the slightest movement the other follows immediately.

The trunks are not parallel, the axes of the vertebral columns diverging perceptibly, making a large V, the apex of which corresponds to the union of the pelves. Each trunk is bent on itsel at an angle of 45°, to give the faces their proper positions. Moreover, the heads are inclined a little toward each other, for the same reason. The contact of the trunks is less—although Rosa-Josepha is only thirteen years old—than that of the double mon-

[1] From the *Revue Scientifique.*

ster Millie-Christine, aged twenty-two, in whom the right shoulder of one individual touches the left of the other.

The faces of these two little girls closely resemble each other; they have a rather old and worn appearance, but the mental and physical strain to which they have been subjected since leaving their own country would account for this to a certain degree.

In figure the resemblance is extraordinary,—much more so than between ordinary brothers and sisters, and even more than is often the case between twins of the same sex.

It is only when one examines them in profile that it can be seen that they are united by the posterior pelvic wall as completely as the famous Hungarian pygopage, Helen-Judith, descriptions of whom may be found in all the old works on monsters.

The angle formed by the bodies—the point of the V representing the trunks—is made by the intimate union of the sacral and coccygean regions at the center, and those of the four nates by the lateral parts. One finds there a real saddle, of which the bony skeleton resembles a wooden saddle similar to those of the Breton horsemen. There is a single pelvis of exaggerated size, consisting of four iliac bones, to which are attached the four legs, which are well formed, if one can judge from the gambols in which these young persons indulge without difficulty.

Beneath the sacral conjunction, in a quadrilateral, dome-like space, limited by the origin of the four lower limbs, there is found a region the description of which is of the first importance in the history of monsters. In the language of a German gynecologist who is very exact on this point, and also of M. Isch-Wall, there would seem at first sight to be a single set of organs; one urethra, one uterus, and one anus. It is certain, however, that there are two bladders, for a desire to urinate is not felt by both individuals at the same time; in this they resemble other pygopages, and it is easily understood if one believes that the allantoides are formed when the union of the embryos takes place, and by reason of their very anterior situation, they are not close to the point of contact, which is posterior.

The other internal genital organs are double.

The rectum is probably single for some distance, as they are actuated by a single impulse to defecate; but there are undoubtedly two large intestines.

According to Breisky, at the age six months there was a remarkable asymmetry of the heads of the two children, very noticeable if one looked at them from above or behind.

As regards psychological phenomena, it is now well known that monsters of this kind constitute two distinct personalities, and that one has to deal with individuals where brains function entirely independently of each other.

The two girls speak "Czech,"—that is to say, the language of their native land. They can occupy themselves in many ways independently of each other. One sleeps while the other is awake. The showman relates many amusing stories about the different sensations that they experience, but these need to be verified. It has been proved, however, that they have not the same tastes in the matter of food. One likes beer, the other wine; one is fond of salad, the other detests it, etc., etc.; when one is thirsty the other does not necessarily experience the same sensation.

The two hearts do not beat in unison, for the radial pulses are not synchronous.

With Millie-Christine, Paul Bert demonstrated that a touch on the lower limbs of one individual was perceived by the other; whence it was concluded that the *caudæ equinæ* of the spinal marrow were united. It does not seem to be so with Rosa-Josepha; there is only a very restricted zone in which a sensation may be experienced by both at the same time, and this zone corresponds to the middle part of the skin which covers the transverse mass placed between the pelves,—a place where it might be possible to separate the two girls if it should become necessary through the death of one of them. It can be inferred from this that the union is less intimate than in the case of Millie-Christine, and that if the spinal canals communicate at the level of the sacrum—which is probable—the cords are either not united at all or but slightly.

The movements are supple and graceful. When one walks the other does not have to walk backwards. Progression takes place in many ways that would take too long to describe here. Ordinarily, as with Millie-Christine, the two internal feet advance together, then the two external ones. Rosa-Josepha can walk, each by herself, the one carrying the other. The walker throws herself a little in advance, the one who is carried resting on the other's hip, having only to lift her feet a little from the ground. Sometimes they walk on three legs, or even two, going up stairways, and practicing the dancing lesson which is given them every day.

The pathological history of their pygopage would be very interesting if it could be exactly known. It is on record that one of the children was sick, when a year old, with croup which the other did not have. Shortly after the well individual was seized with convulsions, which did not attack the one which had had the croup.

The case of Rosa-Josepha is not entirely analogous and comparable to the two other pygopages, Helen-Judith and Millie-Christine. The former, who has disappeared from public view since 1874, had the spinal cords united, but in Rosa-Josepha this does not seem to be the case. In other respects these two girls resemble Helen-Judith, and they probably constitute a type intermediate between the latter and Millie-Christine.

EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

THE question is often asked the editors, With but limited funds, what journals related to biology should our college take? As others may be in the same position as these inquirers, the answer is made here. Of course this journal should occupy the first place, since it is the only American periodical which regularly presents abstracts of the more important papers in all departments of natural history. Next in importance is the *Journal of the Royal Microscopical Society* (London, $7.50 a year), which, besides one or two original papers in each number, contains abstracts of work done in botany, zoology, and in microscopy and microscopical technique. The *Zoologischer Anzeiger* (Leipzig, $4) presents every two weeks original communications upon zoology, and also a classified list of all zoological publications from all parts of the world. The *Anatomischer Anzeiger* (Jena, $4) contains only anatomical and embryological papers, and an index to the current literature of those subjects. The *Biologisches Centralblatt* (Erlangen, $4) is made up of original communications and longer résumés of zoological and botanical papers.

In the line of botany every library should have the *Botanical Gazette* (Crawfordsville, Indiana, $2) and the *Bulletin of the Torrey Botanical Club* (New York, $2). For the larger and more important papers the *Annals of Botany* (London), the *Annales des Sciences Naturelles Botanie* (Paris), the *Botanisches Centralblatt*, and the *Jahrbücher für wissenschaftliche Botanik*, are the most indispensable.

For the original contributions to zoology the most useful are the *Journal of Morphology* (Boston, $9), the *Quarterly Journal of Microscopical Science* (London, $10), the *Zeitschrift für wissenschaftliche Zoologie* (Leipzig). Where more funds are available this list can be indefinitely increased.

—The organ of the Brooklyn Entomological Society, *Entomologia Americana*, has ceased with the completion of its sixth volume. In the years which it has been running it contained a number of valuable papers on entomology, and especially was it noted for its synopses of the various groups of insects. In another aspect the demise of the journal is not to be regretted, for its editors apparently allowed everything that came to be published, and the result was that each number contained several articles each about a page in length. Such a course does not advance entomology; it is rather a drag upon it, for no one can by any possibility keep track of the multitude of short notes thus poured out, and by-and-by there may be quarrels resulting because somebody's ten-line squib has been overlooked. *Entomologia Americana* was, however, not alone in this fault.

—Uniformity is in many respects desirable in many things, but uniformity may result in deformity. What a world this would be were all men to think alike! The editors of the American Naturalist have their little differences of opinion, but this does not interfere with the conduct of the magazine. For instance, one of our number exhibits tendencies towards a strict uniformity in geological nomenclature, while the other is more conservative, and perceives deformity in the uniformity of the newly modified names of the geological (geologic) ages. Triassic and Jurassic are good and long-accepted terms, but Siluric and Cretacic have a barbarous sound. Carbonic has a flavor of the deadly CO_2; and then Cambric!—it recalls handkerchiefs and pillow-slips, and anything except ancient Wales. However, the advocates of the new "terminatiology" are not thoroughly consistent. Ancient roots should not stand in the way of Eocic, Miocic, Pliocic, and the like, when uniformity is to be gained.

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RECENT LITERATURE.

Geological Survey of Arkansas, 1889.[1]—This volume of the Geological Survey's reports relates principally to Crowley's Ridge,—the only marked topographic prominence in the country between Little Rock and Memphis, the geology of which is most admirably discussed by R. Ellsworth Call, who contributes, also, notes on the forest trees of this region, and a description of a new mollusk, *Mytilus harnatoides*, from the Tertiary of Eastern Arkansas. Prof. R. D. Salisbury has a chapter upon the relations of the northern drift to the Plistocene deposits, where he clearly sets forth the succession of events in the northern part of the United States during Plistocene times, and points out the relations of those events to the influences that shaped Crowley's Ridge and its adjacent territory. A valuable paper from Prof. F. H. Knowlton, on the "Fossil Woods and Lignites of Arkansas," and a brief explanation from J. C. Branner as to the origin of Crowley's Ridge, make the report on this region of Arkansas complete.

Zoological Geography.[2]—The study of the zoological distribution of animals is one which is making continual advances. It is with the view of presenting the principles of this science in a comprehensive yet brief and simple manner that M. Trouessart has written this book. It is one of the *Bibliothèque Scientifique Contemporaine* series, and, like the others of that admirable set, is well illustrated with pictures, diagrams, and tabulated statements to express at a glance the author's meaning.

In general, the greater divisions established by Sclater and Wallace have been followed, but some changes have been necessitated by the progress made during the last five years.

In chapters I. to V. the author describes the great continental regions which have been distinguished according to the distribution of the higher vertebrates. Chapter VI. is a study of the means of the dispersion of animals, both by their own locomotive powers and by agencies outside of themselves. Here, also, will be found a sketch of the faunal characters of the different regions,—a branch of the subject

[1] Annual Report of the Geological Survey of Arkansas, 1889. Vol. II., "The Geology of Crowley's Ridge," by R. Ellsworth Call, M.S.

[2] La Géographie Zoologique. Par Le Dr. E. L. Trouessart. Librairie J. B. Bailliere et Fils, Paris.

too often neglected. The second part (chapters VII. to XI.), describes in detail the successive and regular distribution of each class of animals, the classification being based on their means of locomotion. In the last chapter the author calls attention to the relations existing between paleontology and zoological geography.

M. Trouessart is to be congratulated for the masterly way in which he has presented the subject, and on his success in popularizing it.

The Ancestors of Our Animals.[3]—This exceedingly attractive little book is one of the *Bibliothèque Scientifique Contemporaine* series. In it Dr. Gaudry has combined the ideas concerning the origin and development of animal life previously published in scattered articles. There is a resume of his works on Pikermi and the Leberon which will be appreciated by students who have been unable to procure the original volumes. Finally a chapter is devoted to the paleontological work done in the Museum of the Jardin des Plants. M. Gaudry has introduced many figures to illustrate the text, many of which are restorations, and give the general reader a better idea of the animal than could be obtained from the fragments of bones which mean so much to the student. The book is a capital demonstration of scientific facts made popular. Prof. Gaudry states that he has been materially assisted in this work by M. Marcellin Boule.

Morphology of the Avian Brain—This is the title of by no means an unimportant contribution to the first volume of the *Journal of Comparative Neurology*, of Cincinnati, by Mr. C. H. Turner. The memoir includes over fifty octavo pages, and is illustrated by five plates, three of which are folding. They present many figures of brains, of divers views, of different birds of this country. There are also sectional microscopical views. Mr. Turner informs us that his investigations are based upon the study of "over one hundred and fifty birds, belonging to nine orders, twenty families, more than forty genera, and about fifty species." A brief but clear account of his methods of research is given, and this is followed by his remarks upon the external form of the bird's brain in general, followed in turn by sections devoted to descriptions of the various parts, as the rhinencephalon, the prosencephalon, the hemispheres, the mesencephalon, the diencephalon, the epencephalon, the metencephalon, and finally the cranial nerves. Measurements and ratios of all these structures are given under the

[3] Les Ancêtres de nos Animaux dans les Temps Geologiques. Par Albert Gaudry. Libraire J. B. Bailliere et Fils, Paris, 1888.

various divisions treating of them. He republishes Coues's description of the cranial nerves as presented in his second edition of the "Key" to North American birds, and states that he is in error when he says that the "optic lobes are never covered" in the avian brain by that part of the encephalic mass above them (p. 50).

In the second section is discussed the "Relation of Brain Measurements to Taxonomy," wherein the classifacatory schemes for birds given by Huxley and Parker are contrasted, and a special table treating of the taxonomy of the North American Passeres as it has been given by Coues, the A. O. U., and by Shufeldt, is also presented.

Mr. Turner supports the views of Shufeldt with respect to the position in the system of the Corvidæ, the Icteridæ, the Fringillidæ, and the Turdidæ, and departs but slightly from him in the other families. In giving the Paridæ a high place, he agrees with Coues, but gives Shufeldt due credit for having long ago pointed out their being a very highly organized group of birds.

Although the present writer has adopted, in one or two instances, the exhibition of the affinities of families by means of tabulated serial lists, I must say here that upon the whole the scheme is very deceptive and often misleading. It is very much like an attempt to show the mode of growth and branching of a tree by similar means. It is quite out of the question. I consider that we have twenty families in the group Passeres in this country, and Mr. Turner has dealt with but *ten* of them. Further investigation may induce him to recast to some extent his taxonomical scheme of the North American Passeres, and we trust that such studies will soon be forthcoming.

Space will not admit of my giving Mr. Turner's valuable recapitulation of his observations upon the avian brain here, and I must be satisfied with this brief notice of a paper that will well repay the careful reading of all those interested in vertebrate morphology, and in the structure and natural classification of birds in particular.—R. W. SHUFELDT, *August 10th, 1891.*

General Notes.

GEOGRAPHY AND TRAVEL.

CHATHAM ISLAND, GALAPAGOS ARCHIPELAGO, Aug. 28, 1891.

Having returned from a trip of two months through the Galapagos Islands, I take the opportunity to send you a few lines about the progress of the expedition. As you know, Mr. C. F. Adams and myself left New York on May 1st. Having direct connection at Panama, we reached Guayaquil May 13th. Unable to find any convenient ship to take us to the islands, we had to stay at Guayaquil until June 1st, on which day we sailed on a schooner to Chatham, the most eastern island of the group, on which the hacienda of Senor Manuel Cobos is placed. We arrived at Chatham June 9th. Here we remained, examining the island and making extensive collections, until June 26th. From this date to August 26th, when we returned to Chatham, the following islands were visited: Charles Island (stopped at three different ports and went over the whole island), Hood, Barrington, South Indefatigable, Brattle (not landed), South Albemarle (opposite Brattle), Grossman (not landed), Duncan, West Indefatigable, Jervis, East Albemarle (opposite Cowley), West James, North James (two different ports visited), North Chatham, West Chatham.

On the second trip we intended to visit the following islands, and all arrangements had been made: Tower, Bindloe, Abingdon, West Albemarle, Narborough, Weismann, and Culpepper; but on my return here I found news from home which necessitated my return at once. Therefore I proposed to make only a short visit to the most important of the above islands—Tower, Bindloe, Abingdon—on my return to Guayaquil.

The following collections have been made: Mammals, birds (so far about 600 skins prepared by Mr. Adams, and the same number in alcohol), reptiles (many hundred specimens, complete series of Tropidurus from all islands), spiders, land shells, insects, etc. The flora I have collected as much as possible of every island touched at.

No mammals had been collected on these islands since Darwin's visit in 1835. Mr. Adams shot a bat on Chatham (the first one ever collected) and saw one on Albemarle. Hesperomys was secured on

Barrington (eight specimens), South Albemarle (one specimen), Duncan (one specimen), East Albemarle (one specimen); on Chatham one was observed. There cannot be any doubt that this mammal is an original inhabitant of the group.

The birds are exceedingly interesting, and I hope to be able to give a satisfactory solution of the Geospiza question. As I have shown in a paper published in the *Biologische Centralblatt*, the Iguanoid Tropidurus is represented by a single species on each island, and nearly every island contains a different species or race of Tropidurus. This has been absolutely sustained. Now in the plastic genera of birds we find exactly the same. Let us first consider the genera Nesomimus and Certhidea, of which only a single species is found on each island. The genus Nesomimus is represented by a different species or race on every island, and there is never more than one species or race found on one island. The same is true of Certhidea, but this genus is not quite so plastic. On Hood, as it is known, Nesomimus is much different from the other species; but so are Certhidea and Tropidurus. On the central islands—Chatham, Indefatigable, Jervis, James, Albemarle—Nesomimus shows only slight differences; but so do Certhidea and Tropidurus. What I want to state is the absolute harmony in the distribution and the grade of difference in these forms. This is also true of the flora, as far as I could make out.

It is now necessary to examine such genera as Geospiza, Camarhynchus, and Cactornis, which are represented by a greater number of species on one island. As it is well known, there has been a great uncertainty as to the number of species found one ach island; on some islands not less than eight species have been recorded.

So far as my present investigation reaches, probably on none of the islands visited is the number of species greater than three; but these three species vary nearly on each island, each separately, as if they would represent three different genera. The same view I have for Camarhynchus and Cactornis, and all such genera which contain more than one species of a genus on a single island,—like Bulimus, for instance. But often we find that the highest number of species is not reached by every island, but that the number of species is reduced. This can be explained by the extinction of one of the species. In this respect I have first to make some remarks about Nesomimus. As is known, Nesomimus existed on Charles Island in 1835 when Darwin visited the island; it still was found there in 1868 during Dr. Habel's visit. We did not see a single specimen on Charles Island, notwithstanding the whole island was crossed and three different ports were

visited, and there is hardly any doubt that Nesomimus is extinct on Charles Island; and the same is true of Duncan. We have been all over the island, and not a single specimen was seen. On all the other islands Nesomimus was exceedingly common. It is highly interesting to see that Tropidurus is greatly reduced on Charles Island. During my whole stay there I saw two specimens, of which I was fortunate enough to secure one. I do not need to state that I took the greatest pains to find more. On Duncan only twelve specimens could be secured after long hunting. On all the other islands Tropidurus is exceedingly frequent. Exactly the same we find in such genera which are represented by different species on one island.

One or two, perhaps three, of the "three original species" may be extinct. This condition can only be explained by the subsidence theory, which, as I have stated in my article published in your journal, also gives the only satisfactory explanation of the harmonious distribution and differentiation of fauna and flora.

My opinion is that at the time when these islands were still in connection there existed already a great number of species of certain genera. As soon as separation begun each of these species was differentiated for itself, just in the same way as if it were a genus. It might happen that one or more, even all, of the species of such a genus became extinct on certain islands, or were not present there during the time of separation.[1]

Let us suppose the number of the species of Geospiza was four in the time when these islands were still in connection. These four species may be called a, b, c, d, and may be represented by *G. fuliginosa*, *G. fortis*, *G. strenua*, and *G. dentirostris*, which latter species I have not yet seen. a, b, c, d is dependent on the different conditions on the different islands; taking three islands with the conditions x, y, z, we can express the species on these three different islands, which formerly were all in connection, in this way:

1st island, $a \times f(x) - b \times f(x) - c \times f(x) - d \times f(x)$
2d island, $a \times f(y) - b \times f(y) - c \times f(y) - d \times f(y)$
3d island, $a \times f(z) - b \times f(z) - c \times f(z) - d \times f(z)$

The greater the difference between x, y, z, the greater the time of separation, which may be expressed by $f(x)$, the greater will be the

[1] I may state here the fact that North Chatham, which is separated from the principal portion by barren lava fields, does not contain a single species of Camarhynchus, nor Nesomimus, nor Certhidea.

difference of the species. If one or the other of the species dies out, we can have, for instance :

1st island, $a \times f(x)$ — o — $c \times f(x)$ — $d \times f(x)$
2d island, o — $b \times f(x)$ — o — $d \times f(x)$
3d island, o — o — $c + f(x)$ — o

This, I think, will be sufficient to express my opinion on the differentiation of such genera which contain more than one species.

Now some words about the birds themselves. Creagrus, of which, so far as I know, only four specimens exist in the museums, has been considered a very rare bird ; all the authentic specimens of which have been collected at Dalrymple Rock, west of Chatham. This bird is quite common here. We have seen it near Freshwater Bay, Chatham, between Charles and Hood, and found it in considerable numbers on the rocks in Gardner Bay, and on Gardner Island, near Hood, in hundreds of specimens ; it was seen on Brattle, where many specimens were collected ; it was also found on a rock north of Sullivan Bay, James, and on the Seymour Islands, north of Indefatigable. Creagrus is probably found on every steep rock which contains holes, in which the bird breeds.

On Albemarle, from which island only a few species of birds were known, we found over forty species (South Albemarle), a number greater than ever recorded from any island. *Geospiza magnirostris*, not observed since Darwin, was found on South Albemarle and Jervis ; it is simply the representative of *G. strenua* of other islands, as *G. conirostris* is the representative of this form on Hood.

I will conclude this letter with a few words about the reptiles. Of Tropidurus I have already spoken. Geckos were found in great numbers on Charles (one species, *G. galapagoënsis*), on Albemarle, and on Chatham. Snakes I observed on Hood (one specimen collected), Barrington, and Albemarle. Conolophus exists in great numbers on Barrington and the Seymour Islands, but was not noticed on any of the others. Amblyrhynchus is found on all islands, but is rare on some ; on Charles only two specimens were seen.

The land tortoises are extinct on Charles, Chatham, Barrington, and Jervis, on which islands they formerly existed. They are probably extinct on Hood, on which a thorough search of two days over the whole island was without result. They are said to still exist in reduced numbers on James (an examination of two days was without result) and on Indefatigable. On South Albemarle, where we remained twenty days, we found the land tortoises still in considerable numbers, but it is

exceedingly difficult to reach the places where they live. We secured eight living ones, of different size: five with shells one meter or more in length, and one, probably the largest one ever taken from the islands, with the carapace one meter and forty centimeters in length. You may imagine the amount of work when I tell you that these specimens had to be carried from eight to twenty miles over the lava fields and through the densest brushwood.

I do not need to say that there was no possibility of bringing the large tortoises down alive. The largest one must have had a weight of 400 pounds. On Duncan we secured eight tortoises; they are much smaller than the forms from South Albemarle, and resemble the Abingdon specimens. On the northeast side of Albemarle I tried to penetrate to the interior, but had to return after two days on account of the nearly impassable lava fields.

So far I can say that the expedition has had the greatest success, and I am convinced that my expressed opinion on the origin of this group of islands is the correct one. I may add that in a single instance (near Barrington) I have found a land bird flying over the ocean; it was the common *Dendrœca aureola*, found on all islands. It is certain, therefore, that these birds do not travel from one island to the other, as is also fully sustained by the collections.

The birds are still as tame as formerly, especially on such islands which are not often visited. On Duncan a *Buteo galapagoënsis* sat down on a bush next to me. I touched him with a stick; he did not move. I began to tickle him on the head; this he seemed to like; and an hour later, when I had gone to a smaller island near that place, he also came over and sat down next to me to be tickled by the stick. Myiarchus is the tamest bird, and often sat down on my hat or my stick when I kept quiet.

I finish this letter, hoping that the expedition will be followed by others of the same nature. Biology is of the greatest importance for dynamical geology, and is in many cases the only source of information. The Fiji or Friendly Islands, which are considered as oceanic islands, but which I believe to be continental, ought to be examined, and also a group of islands which is doubtless of oceanic origin. Harmony or disharmony in the distribution of flora and fauna will always, I think, solve the problem of the origin. That variation goes on in definite lines, determined by the nature of the conditions, I am fully convinced. The theory of natural selection, especially the view of the "Neo-Darwinians," has not received any support; but more about this question later.

I left Chatham on September 1st for Tower Island. This island was very interesting, having never been visited before. Creagrus was found there in great numbers, breeding, besides Fregetta, Sula, and Phæthon. Of Fregetta a considerable number of embryos and nestlings were procured. Of land birds the following species were found: Geopiza, two species; Cactornis, one species; Nesomimus, one species; Certhidea, one species; Dendrœca, one species; the dove and owl were also observed. Not a single specimen of Tropidurus was seen; Amblyrhynchus is frequent, but small.

From Tower we went to Bindloe. All the birds collected by Dr. Habel were also obtained. Tropidurus is very common, and quite distinct from the Abingdon form. Nesomimus, which had not been recorded before from this island, is a very abundant bird.

On Abingdon we remained only a very short time. Nothing new is to be added to the results of Dr. Habel and the "Albatross."

We reached Guayaquil September 16th, and sailed to Panama on the 19th on the "Santiago."—G. BAUR, *Clark University.*

GEOLOGY AND PALEONTOLOGY.

The Desert Sandstone of Australia.—A paper by Mr. Charles Chewings, published in the Proceedings of the Royal Geographical Society, June, 1891, contains the following interesting account of the "desert sandstone" of Central Australia:

"At what period or periods the Lake Eyre depression was formed has not yet been satisfactorily decided; but we may fairly conjecture that an opening at one time existed to the south into Spencer's Gulf. During Cretaceous times, however, that and all other outlets were things of the past, and the detritus from the Macdonnell and James ranges, as well as many other high lands, was washed into this large basin, of which, so far as ascertained at present, the outline extends from the Coast range, situated a little south of the Gulf of Carpentaria, westward nearly to the overland telegraph line. It then runs northeast towards Lake Eyre, and, skirting the Macdonnell ranges elevation, curves round to the north of the Charlotte Waters telegraph station, in about the latitude of Lake Amadeus, which lake it approaches, if not includes. This is probably the western boundary of this system.

"From Lake Amadeus the Lake Eyre system extends northeasterly towards Port Augusta, takes a curve to the eastward, and runs along

east and west a few miles to the south of Lake Eyre. It then makes southeasterly for Barrier, and taking a long sweep to the east and north embraces the extent of those rivers that flow from south of the Gulf of Carpentaria into Lake Eyre. The shape is semicircular, and crescent-shaped, extending towards a half moon. No doubt detritus from the extensive area covered by the already-mentioned red sandstone formation contributed largely towards filling it up to a level much higher than the present level of the country; this is easily seen by the numerous tent-hills and table-lands scattered throughout the area of the basin, ranging from 200 to 500 feet high, of which Chamber's pillar is a remnant. As the basin sank, or surrounding land became elevated, so the flood waters carried this newer Cretaceous formation to the lowest depression, cutting deep gullies and wide waterways through the newer deposits, and generally lowering the basin. This has been going on probably from time immemorial; certainly from Cretaceous (secondary) age, down through Tertiary and Quaternary ages to the present time. When the seas that washed the softer and newer deposits away from the Macdonnell ranges and laid bare much of the primary rocks had subsided, and Central Australia was elevated quite above sea-level, and long ages of scorching summers had evaporated its larger lakes and surface waters, and the Cretaceous age (during which Lake Eyre was an inland sea) was rapidly becoming a thing of the past, a newer influence, and one that exists to-day,—viz., that of the wind,—probably blew into all secluded and rock-bound spots, depressions, shallow lakes, and like places the sandy weatherings from around their base, and a newer formation was the result. This is the commonly called 'desert sandstone,' for what reason I have never had a satisfactory explanation. Both as a shallow-water deposit and a dry wind-blown deposit it retains its unmistakable characteristics. Its color is that of an ordinary grindstone, and it consists of horizontal layers, the cap of each being harder than that underneath it. By weathering its sides get hollowed out, and in the caves thus formed the aborigines find a refuge from the extremes of weather, often painting devices on the walls.

"The great extremes of heat and cold, a dry atmosphere, and strong winds caused through radiation, tend to constant degradation of the rocks, the detritus being blown into sand-hills and distributed throughout this large area. In Western Australia, along the line of route taken by the Hon. John Forrest, surveyor-general of Western Australia, in lat. 26° S., a sandstone is met with that covers all other rocks from E. long. 122° to E. long. 126° 30′. In this extensive area of 'desert sandstone' all the rising ground is composed of it. 'Very often one

side of the rise forms a cliff.' Further to the north the late Colonel Warburton found this same sandstone formation taxed his camels to the utmost. In the eastern colonies a desert sandstone exists, but whether similar to that in Western Australia, I cannot say. Mr. Woodward has satisfied himself that this formation overlies most, if not the whole of the western coast formations from Cambridge Gulf to King's Sound, and that it extends far inland towards Central Australia.

"Under this sandstone formation the Carboniferous series he describes as well developed, and if it continues right across the continent, as it does in China, coal deposits may yet be found in the interior of Australia. He has also discovered a large lava flow in the northwest, and fixes the Leopold range as of Carboniferous age; also that the coast of Western Australia is rapidly rising, and he describes the sandstone area as extending inland 'as a vast table-land of from 1,000 to 2,000 feet above sea-level. No volcanoes exist in the colony of Western Australia, and the general appearance of the country throughout indicates a condition of remarkable quiescence, continuing even further back than the Carboniferous epoch.' He describes the rivers, for the most part, as 'simply immense storm-water channels. Several large rivers have their sources in the western edge of this plateau, and cutting deep gorges through their upper horizontally bedded rocks, expose the underlying crystalline rocks across the strike of which they have cut their channels,' and considers that 'precious stones may be found in the amygdaloid regions. The mineral-bearing districts have been greatly decomposed and altered by thermal waters and steam at the time of the deposition of the lodes, and later by the heat evolved by the oxidation of the metallic sulphides.' He corroborates the opinion that the uppermost or desert sandstone is of terrestrial origin, and probably formed shortly after the elevation of this continent. In places these beds are of terrestrial origin, there is not the slightest doubt; in other places the indications point to a swampy or lacustrine source."

Structure of the Piedmont Plateau.—Prof. Williams, of Johns Hopkins University, offers the following hypothesis as to the structure of the Piedmont region in Maryland:

"That the eastern area is composed of rocks far more ancient than the western, which extend out under these, forming the floor upon which they were deposited; and that although already much folded and metamorphosed, this crystalline floor underwent at least one more folding after the schists had been laid down, carrying these with it and

involving them in a considerable but not an extreme amount of disturbance and metamorphism."

The hypothesis seems to account for the difference between the rocks of the two areas and for the abruptness of their contact, while at the same time it explains the conformity along this contact, and the fact that this boundary and the axes of the synclinals are not coincident. (Bull. Geol. Soc. Am., Vol. II., pp. 301–322, pl. 12.)

The Triassic of Massachusetts.—Mr. Benjamin Emerson does not accept the theory that the Triassic deposits of Massachusetts are, as a whole or in part, of glacial origin, but that they result from currents. This will explain the sudden and irregular transitions from coarest to finest sediments, and the derivation of many of the coarse beds from rocks not known in place among the crystallines of the surrounding region. He believes the region to have been a narrow bay, with tides that swept up the eastern and down the western side, and left the center of broad, shallow mud-flats at a considerably higher level than the shoreward portion, so that they alone were regularly abandoned by the water at low tide. It follows from this that the deposits were contemporaneous, and this is shown by the position of the trap sheets. (Bull. Geol. Soc. Am., Vol. II., pp. 451–456, pl. 17.)

The Relations of the Traps of the Newark System in New Jersey.—Mr. N. H. Darton makes known the following facts:

"The trap outcrops inclosed by the Watchung Mountains of Northeastern New Jersey, and the outlying mass near New Germantown, are lavas, contemporaneous with the inclosing sediments, while all the other traps described are intruded sheets and dikes.

"The igneous rocks are basalts, the eruptives are fine-grained and generally somewhat glassy, and the intrusives are coarser-grained, generally being dolerite, in some cases including considerable biotite and often near gabbro in structure.

"The great hooks characterizing the southernmost outcrops of the Watchung traps are mainly due to flexure, and the bowed course of their northern terminations and of Towakhow Mountain are due to the same cause." (Bull. U. S. Geol. Surv., No. 67.)

The Iron Ore District of East Texas.—The second annual report, 1890, of the Geological Survey of Texas contains an interesting account of the iron ore district of East Texas, by Mr. E. T. Dumble. The territory described lies east of the 96th degree of longitude and north of the 31st parallel of latitude. From this area is

excluded, as being non-iron-bearing, the portion north of Sulphur Fork, and also the northwestern corner, in which the black waxy prairies of the Cretaceous are the prevailing formation.

In this district, so restricted, there are nineteen counties, containing in the aggregate 14,430 square miles. In each of these counties iron ore exists in greater or less quantities and of varying qualities.

The region is underlaid for the most part by strata of Cenozoic age. In only a few places are there exposures of Cretaceous strata, and when they do appear as inliers they belong to its uppermost members and are accompanied by salines.

Meniscotheriidæ and Chalicotherioidea.—The Meniscotheriid family of Condylarthra, which has been found only in the American Wasatch, and is represented by a single genus, has always been placed in a very doubtful phylogenetic position. Dr. Wortman in 1886[1] was inclined to "regard Meniscotherium as the direct ancestor of the Hyracoidea, notwithstanding their wide separation in time and space." Schlosser in the same year[2] recognized the striking likeness of the molars of Meniscotherium to those of Chalicotherium, which was at the time believed to be a true perissodactyl, so that he naturally did not trace any ancestral relationship between these forms. He considered Meniscotherium (*op. cit.*, p. 120), with Macrauchenia, to be Perissodactyla which had retained a very primitive foot structure. Since this paper was published Chalicotherium has been removed to a separate division of Mammalia, affiliated to the Perissodactyla, but representing a distinct line.

I find there are many striking resemblances between the dentition of Meniscotherium and Chalicotherium, and it appears to me probable that the Wasatch genus is related to the ancestral forms of Chalicotherium. The resemblances consist (*a*) In the enlargement of the posterior half of the dental series, and reduction of the anterior half. (*b*) The upper molars are of precisely the same pattern; the protocone is isolated; the hypocone and metaconule are united in a short transverse crest. (*c*) The similarity in the lower molars is seen especially in the reduplication of the metaconid in both forms, and the absence of the third lobe upon the last lower molar.

The differences between these genera are such as separate many higher from lower types, in the displacement of the foot bones and

[1] "Comparative Anatomy of the Teeth of the Vertebrata," p. 476.

[2] "Beit. z. Kennt. Niss der Stammes-geschichte d. Hufthiere," *Morph. Jahrb.*, Band 12, p. 21.

evolution of the teeth. Chalicotherium shows a diplarthrous condition of both carpus and tarsus and no fibulo-calcaneal facet; there is no third trochanter; the anterior intermediate cusps of the upper molars (protoconule) is reduced.

We shall remain in the dark as to the truth of this suggestion until we find the complete feet of Meniscotherium. In the meantime the striking resemblances seen in the teeth point strongly towards a distant relationship between these forms.—HENRY F. OSBORN, *American Museum of Natural History, New York, August 27th, 1891.*

The Family of Astrapotheriidæ.—Senor Alcides Mercerat has recently published a paper on the Astrapotheriidæ, to which he refers two new genera, Listriotherium and Xylotherium, as well as Burmeister's genus, Astrapotherium. Listriotherium is represented by two new species: *L. patagonicum* Merc., from the Eocene of Monte Leon, and *L. filholii* Merc., from the Eocene of Santa Cruz. Xylotherium has but one representative, *X. mirabile* Merc., also from the Eocene of Santa Cruz. To Astrapotherium belong *A. patagonicum* Burm., *A. augustidens* Merc. sp. nov., *A. marshii* Merc. sp. nov., *A. gaudryi* Merc. sp. nov., all from the Eocene of Mt. Leon, Patagonia; also *A. magnum* Owen, *A. burmeisterii* Merc. sp nov., *A. robustum* Merc. sp. nov., from Santa Cruz, Patagonia, and *A. voghtii* Merc. sp. nov., from the Eocene of Chubut. (Extr. Rev. Mus. de la Plata, Tomo I.)

On a Skull of the Equus excelsus Leidy, from the Equus Bed of Texas.—I have received from my valued correspondent, William Taylor, a skull of the *Equus excelsus*, which is of much interest as the first that has come to light in the United States. It lacks only the posterior and inferior walls of the brain-case, and the premaxillary region was detached in such a way that its length is not absolutely certain, though contact of the adherent matrix was found. This skull shows that the *Equus excelsus* is intermediate in characters between the horse and the quagga and allied species, and possesses some Hippidium characters in addition. The resemblance is, however, greater to the quagga. This is shown by the shortness of the premaxillary region, the abbreviation of the maxillary posterior to the last molar, and the long excavation of the posterior nares, which extends to the line of the anterior border of the penultimate superior molar. It differs from both of these species in the posterior prolongation of the vomer over the presphenoid, and in the small size of the last superior molar. The latter tooth is smaller than

the penultimate, as in the species of Hippidium and the three-toed horses. The glenoid surface of the squamosal is of nearly uniform width, as in the Hippidiums, and not expanded at the external extremity, as in the horse and quagga. The *E. excelsus* differs from the quagga in the very slight decurvature of the symphyseal portion of the premaxillary bone. It approaches nearer the horse, but is even flatter. The incisor teeth do not exhibit the anterior longitudinal grooves of the crown seen in the two recent species mentioned. The patterns of the crowns of the superior molars are much like those of the two species named, but the internal inflections of the anterior and posterior borders of the external lakes are not so deep as in one or both of those of the *E. quagga* and *E. caballus*. The size of the skull is about that of the quagga.

The skull is that of an adult female. The frontal bone is crushed in between the orbits so as to crush the descending anterior plates of the former behind the nasal cavity. The free orbital borders and the pariêtal bones are not crushed. It is singular that that part of the arch of the skull which presents the strongest resistance to pressure is crushed, while the weaker regions remain entire. Unless a stone occupied the exact position calculated to produce this result, it might be imagined that this horse was knocked in the head with a stone hammer, such as has been found in the same bed by Mr. Taylor.—E. D. Cope.

The Glacial Deposits at Hendon, England.—In a paper read before the London Geological Society, May 27th, 1891, Mr. Henry Hicks showed that glacial deposits had been spread out to a much wider extent over the Hendon plateau than had hitherto been supposed. There is evidence to show that these deposits have extended in a south and southwest direction across the Brent and Silk valleys, and now occur on most of the heights in the parishes of Kingsbury and Willesden. As the sands, gravels, and boulder clay which cover the Hendon plateau are found to rest on an undulating floor of London clay, the author considers it clear that the main physical features of this portion of Northwestern Middlesex were moulded at a very early stage in the Glacial period, and before the so-called middle sands and gravels and overlying upper boulder clay were deposited. At this time there could have been no barrier of any importance to prevent these deposits from extending into the Thames valley, and the evidence clearly points to the conclusion that the implement-bearing deposits on the higher horizons in the Thames valley should be

classed as of contemporaneous age with the undoubted glacial deposits at Hendon, Finchley, and on the slopes of the Brent valley. Mr. Hicks is therefore satisfied that man lived in the neighborhood of the Thames valley in the early part of the Glacial period, probably in pre-Glacial times. (*Geol. Mag.*, July, 1891.)

BOTANY.

Botany at the Washington Meetings.—From the 12th until the 29th of August there were almost constant sessions of scientific men in Washington at which botanical papers were presented. In the first place, the Association of the American Agricultural Colleges and Experiment Stations held a four days' convention, and during the opening session there was a report from the chairman of the botanical section of the work done at the various stations by the botanists thus employed. It was evident from this report that while systematic botany, making of collections, and the field study of various plants were important features, the main one in several states is the study of the fungous enemies of cultivated crops. In the meetings of the section of botany much time was spent in a consideration of the question of an exhibition to be made by the stations at Chicago in 1893. The work in botany will be divided, and those workers best able to exhibit fungi of the cereals will have them in charge, while others take the fruits, etc. Professor Tracy, of Mississippi, is chairman of the Botanical Committee of the Columbian Exhibition.

Professor Atkinson presented a paper upon the cotton fungi, and exhibited several oil paintings of diseased leaves showing the rust, blight "frenching," etc. The question of the importance of common names for fungi came up, and was discussed, with the conclusion that finely illustrated bulletins are the best way to overcome the difficulty. Professor Alwood presented two papers, one upon an apple-leaf blight which is very destructive in Virginia, and the results of his successful crossing of wheats. Many specimens of the latter were shown, and a lengthy discussion followed. A bacterial disease of the cabbage was reported upon by Professor Garman, while Professor Crandall exhibited a quantity of Rocky Mountain June berries, and spoke of them as one of the coming fruits for Colorado. Professor Brewer exhibited some hybrid butternuts, and Professor Halsted presented a paper upon the germination of spores of species of fungi.

During the sessions of the College and Station Association, Mr. R. Worthington, F.C.S., of Rothamsted, England, delivered six lectures,

a large portion of which was made up of botanical matter. The microbes, for example, that take an active part in the nitrification of the soil were shown, enlarged by lantern projection upon a screen, as also were some other forms of bacteria of great interest to agriculture.

During the two days of the meetings of the Society for the Promotion of Agricultural Science there were many botanical papers. Thus Professor Arthur presented the results of field experiments under the title of "A Physiological Basis for the Comparison of Potato Production." Many practical points were developed. Professor Beal considered the description of varieties of strawberries and raspberries. Additional information was presented by Professor Burrell upon the bacterial disease of potatoes that is now quite widespread throughout the country. Professor Forbes treated of a bacterial disease of the chinch bug, while Professor Kedzie still further considered bacteria in his paper upon soil extract in relation to development of tubercles on clover roots. Injurious fungi received attention at the hands of Professor Galloway, who gave results of some experiments made the present year in the treatment of plant diseases, while Professor Halsted outlined conclusions from soaking seed beans to check anthracnose. Professor Green considered arsenic and copper as a fungicide and insecticide, and also gave the results of a treatment of raspberry anthracnose with fungicides. Professor Taft reviewed his work with fungicides for apple scab, and Professor Pammel considered some of the conditions which modify the appearance of parasitic fungi in plants.

The opening day of the American Association for the Advancement of Science had its full share of botany. President Coulter, as chairman of the section of biology, gave an address upon the future of systematic botany, and in the evening Dr. Goodale, as retiring president, unfolded the possibilities of economic botany. These excellent addresses the reader will peruse with much profit as presented in the scientific journals.

On Thursday, at the first meeting of the Botanical Club, Professor Arthur explained the working of some apparatus to be used in physiological botany; Professor Halsted spoke of a fungous disease of the egg-plant; Professor Atkinson showed the connection between a cercospora and sphærella; while Professor Pammel considered some conditions favoring the growth of fungi. In the discussion the importance of making yearly notes of important species was mentioned. Professor Fernow spoke of the value of a national arboretum, and resolutions were offered favoring it. In Section F Professor Atkinson presented a paper upon the structure and dimorphism of *Hypocrea tuberiformis*. Professor MacFarland, of Edinburgh, added another chapter in the history of the Venus fly-trap;

specimens illustrating the peculiar quality of irritability possessed by these plants were shown and the subject discussed. Professor Campbell gave a paper on the prothallium and embryo of *Osmunda claytoniana* and *O. cinnamomea,* fully illustrated by blackboard drawings. A new nectria found upon the sweet potato and associated with the stem rot was treated of by Professor Halsted. The Compositæ collected by Dr. Palmer in Colima, and the flora of Carmen Islands, were two papers by Professor Rose. Professor T. Smith illustrated fully the uses of the fermentation tubes in bacteriology by a score of specimens, many containing important disease germs.

On Friday, during the morning hour for the Botanical Club, papers were presented by Professor Fairchild on a new currant disease, by Professor Riley upon Mexican jumping beans, by Professor Rose upon two new weeds, while one of the most enjoyable features was the presentation to the members of the club of a souvenir by the Washington Botanical Club, consisting of twenty-two photographs of Washington points of interest, neatly bound. In the biological section notes upon bacteria of Cucurbits by Professor Halsted were followed by the four papers of the physiological series prepared by appointment, as follows: "Transportation or Loss of Water in Plants," by Professors Bessey and Woods; "Movements of Fluids in Plants," by Professor Beal; "Absorption of Fluids by Plants," by Professor Pammel; and "Gases in Plants," by Professor Arthur. After some discussion, and particularly as to the absorption of carbonic gas in soil water by roots, the botanical papers for the day in the section closed with notes upon an anthracnose by Professor Halsted. The botany for the day, however, was continued far into the evening by Professor John M. MacFarland, who gave a public lecture upon heredity in plants, by which it was shown with a series of three simultaneous lantern projections that the differences in the parents were blended in the offspring even to the size of cells, ducts, thickness of bark, and many other microscopic details.

On Saturday, at the Botanical Club, the first paper was read by Miss Southworth, on some strange fungi. Dr. Mohr gave a contribution upon some phanerogams of Alabama. A novel method of caring for Myxomycetes was explained by Professor Cook, and Mrs. Claypole gave a paper upon an onion disease. In Section F Professor Riley treated of microörganisms as insecticides, followed by further observations on a bacterial disease of oats by Professor Galloway. Dr. Vasey outlined the botanical field work of his division, while Professor Waite presented results from recent investigations of pear blight. The spectroscope in bacterial studies, by Professor Brashear, closed the long list of botanical papers presented at Washington.—Byron D. Halsted.

EMBRYOLOGY.[1]

Studies in Cephalopods.[2]—Dr. S. Watase, of Clark University, publishes under the above title No. 1 of his contributions on the cleavage of the ovum. The opening paragraph indicates the contents of the paper. "In the following pages I will first attempt to treat the general morphology of the animal ovum from the standpoint of some embryological and morphological facts and theories. In the next place, the relation of the external phenomena of cleavage, as shown in the behavior of the cytoplasm, to the internal phenomena of nuclear or karyokinesis will be discussed. In this connection some theories on karyokinesis will examined, my interpretation of the cleavage phenomena being that they are essentially the analysis of the potential tissues contained in the cleavage nucleus, and this karyokinesis is the method of such analysis and the achromatic spindle the instrument used in the analysis. The cleavage of the squid will then be described, and finally variations in the cleavage of the same animal will be discussed." It is impossible to here go into the theoretical discussions that occupy the larger part of the paper, but the following quotations, taken here and there, may serve to give some idea of the author's convictions. From a review of the literature the author concludes that "however diverse the examples, they all point to one and the same conclusion,—namely, that in the metazoan ovum and its derivations the tissue cells are more than a homogeneous, isotropic mass of protoplasm devoid of a definite symmetry. The study of the karyokinetic figure shows, Van Beneden points out, that the cell is not only unaxial, but also bilateral. In several forms of ova, carefully studied, the axes of the karyokinetic figure correspond in a definite way with the recognizable axes of a given ovum, the external shape of which is chiefly determined by the quantity and distribution of the food yolk. The axes thus determined are maintained through the different stages of growth, and give rise to definite axes of the larvæ or of the adult organism. If these facts be more firmly established by the further investigation of the subject, we may say with Van Beneden 'that the old theory of ***evolution*** is not deprived of all foundation, as is generally believed to-day.'

In this connection a communication from Dr. C. Ishikawa is of great interest,—viz., that the summer and winter eggs of a "certain

[1] Edited by Dr. T. H. Morgan, Johns Hopkins University, Baltimore, Md.

[2] *Journal Morphology*, Vol. IV., No. 3.

form of Daphnidæ undergo different types of cleavage, one being holoblastic and the other meroblastic, the difference being probably produced by the amount of food yolk; the summer eggs belong to the regular holoblastic type of cleavage, and the winter egg to the meroblastic type, showing a close resemblance to the ova of some insects."

The author's view as to the mechanism of karyokinesis is explained. The conclusion is based largely on a study of karyokinesis in the squid and starfish, and the author believes this same explanation may apply to the whole phenomena of cell divisions, the essential point of the theory being that the "archoplasmic filament" radiates from two centers on opposite sides of the eggs penetrate the cell membrane, flattening the chromosomes into a plate, the radiating fibers (archoplasmic filaments), continuing to push, break up the plate into two portions, driving each in the opposite direction,—*i.e.*, away from the archoplasmic spheres. The bilaterality of the egg of the squid is the same as the bilaterality of the adult animal; and the arrangement of the protoplasmic cap at the animal pole also shows well-marked bilaterality, corresponding to that of adult animal.

The Regeneration of the Tail of Lumbriculus.[3]—Miss Randolph has an abstract of her work on the growth of new tails in the Annelids. The new ectoderm arises by proliferation of the ectoderm around the line of fission. From this new ectoderm arises the ventral nerve-chain and the dorsal setæ. The new digestive tract is formed from the cells of the old. The most interesting fact is in the formation of the new mesoderm, which "is formed in great part from specialized cells in the region of the peritoneal epithelium of the ventral longitudinal muscles, on each side of the ventral nerve-cord, between it and the ventral row of setæ. These cells, which I propose to call neoblasts, are distinguished from the cells of the peritoneum by their great size and by the presence of a cell body. They are to be found in every variety, with the possible exception of one or more at the anterior extremity, and represent the 'chorda cells' described by Semper in the Naids and Chætogaster. Very soon after the fission of the worm the neoblasts in the end somite begin to divide, and give rise to the greater part of the embryonic tissue that is afterwards differentiated into mesodermic structures.

"The neoblasts are to be regarded as specialized embryonic cells, set apart for the rapid formation of new mesodermic tissue immedi-

[3] *Zool. Anz.*, No. 362, 1891.

ately upon the fission of the worm. They are present in great numbers in the Naids, where the formation of new tissue is much more rapid than in Lumbriculus, and also in Tubifex, in which regeneration is a very slow process."

Neuroblasts in the Arthropod Embryo.[4]—Mr. William M. Wheeler publishes a short paper on the discovery of neuroblasts or formative ganglion cells in Arthropods. "Carefully made transverse sections through either lateral chord are seen to consist, in early stages, of two kinds of ectoderm elements: smaller ones with rather deeply stainable elongate oval nuclei, and *four large* succulent cells with pale spherical nuclei. These four large cells, the neuroblasts, lie side by side just beneath the smaller ectoderm elements in a plane parallel to the surface of the yolk." The author believes the eight rows of the lateral chords to be homologous with the two rows of cells derived from the neuroteloblasts of Annelids, and "the fact that there are two rows in an Annelid, whereas there are eight in Xiphidium, can constitute on very serious obstacle to this homology." The neuroblasts have been seen in Xiphidium, Melanoplus, Blatta, and Dolyphora.

Morphological Notes from the Biological Laboratory of the Johns Hopkins University.—The anatomical and embryological work done in the morphological laboratory of Professor Brooks is published annually, in the form of complete papers and preliminary notes, in the *University Circular*.[5]

The May (1891) number contains the following embryological articles:

"On the Structure and Development of the Gonophores of a Certain Siphonophore Belonging to the Order Auronectæ Haeckel." By W. W. Brooks and E. G. Conklin.

"Preliminary Note on the Embryology of *Crepidula fornicata* and *Urosalpinx cinerea*." By E. G. Conklin.

"The Anatomy and Transformation of Tornaria: A Preliminary Note." By T. H. Morgan.

"Notes on the Habits and Larval Stages of the American Lobster." By F. H. Herrick, of Adelbert College.

"The Reproductive Organs and Early Stages of Development of the American Lobster." By F. H. Herrick, of Adelbert College.

"On the Early Stages of Echinoderms." By W. H. Brooks.

[4] *Journal Morphology*, Vol. IV., No. 3, 1891.

[5] Vol. X., No. 88, May, 1891.

"Contributions to the Embryology of *Asterias vulgaris.*" By G. W. Field.

The first of these contributions treats of the structure and development of the Gonophores in Rhodalia, from the Pacific Ocean. Haeckel regarded the animal as so unlike all other Siphonophores as to necessitate its being placed in an entirely new order,—Auronectæ. Haeckel's description of the structure of the female (and male) gonophores is shown to be in all probability erroneous. The authors conclude: "The egg-pouch must be regarded as a part of the stem where the growth of the cells may take place while the gonophore is developing. As soon as the gonophore is formed, one of the eggs, already quite large, passes into it, where it lies between the ectoderm and entoderm of the mambrium. Then by the disintegration of the egg-cells remaining in the egg-pouch, and by the formation of large entodermal folds which have a secretory function, the egg is rapidly nourished, and grows to a very large size. The whole arrangement is to secure as rapid a development of the sexual cells as possible," as in the Hydromedusæ.

Mr. Conklin has studied the early stages in the development of Crepidula and Urosalpinx. Of the first four macromeres two meet in the center on a line which Rabl has called the "cross furrow"; the other two are acute towards the center, and do not meet each other. "By the position of the macromeres with regard to the 'cross furrow' the first and second cleavage furrows may easily be distinguished; *e.g.*, if the egg be viewed from the formative pole, and so that one of the cleavage furrows is in the line of vision, the macromere to the right of this furrow and farthest from the observer will be acute at its center if the furrow on the line of vision be the first cleavage furrow; it will be obtuse,—*i.e.*, will meet the opposite macromere in the cross furrow—if the furrow in the line of vision be the second cleavage furrow. Of course the reverse would hold if the egg were viewed from the vegetative pole. The examination of many hundred eggs has shown that the position of the macromeres in relation to the cross furrows and to the first cleavage planes is a constant one."

Urosalpinx differs from Crepidula in the fact that while the four macromeres of Crepidula are equal in size, the four macromeres of Urosalpinx are very unequal, one being much larger than the other three. "Two furrows appear simultaneously, and seem to divide the ovum into one large sphere and two smaller ones. Really, however, one of the smaller spheres is not completely separated from the larger one, and *soon after fuses with it.* This smaller sphere is merely a constricted portion of the larger sphere, and contains the nucleus. Thus

it is seen that of the two furrows mentioned but one is a true cleavage furrow, and it divides the egg into a larger and a smaller moiety. One of these protuberances is cut off to form a macromere equal in size with the two smaller ones; the other protuberance is a part of the larger macromere, and *again fuses* with it. There have thus been formed by two vertical furrows, comparable to the first and second cleavage furrows of Crepidula, three small and one large macromere."

A preliminary note is published by T. H. Morgan on the larva of Balanoglossus,—Tornaria. Reasons are given for regarding the common Tornaria of the New England coast as belonging to a different species from the *B. kovalevskii* of the same coast, so that the parent form is not at present known in connection with the larva. A description is given of the formation of the different organs as they appear in the life of the larva; for instance, the so-called heart (proboscis vesicle or gland) probably originates from a very few mesenchyme cells; the first pair of paired cavities arise as proliferations from two points in the walls of the stomach, and the second (last) pair of paired cavities arise as *solid* folds from the posterior division of the digestive tract (endodermal); the nerve-chord is formed by the collar rolling over the invaginating plate of ectoderm from the two sides, exactly as in Amphioxus. "The similarities of Tornaria to the Echinoderm larva are very numerous, and I cannot believe are due to superficial resemblances. If this be true, the antiquity of the larva must be very great, though *not necessarily ancestral.* The relationship of Balanoglossus to the vertebrates seems more than probable, as Bateson has pointed out."

The two papers by Prof. F. H. Herrick on the American lobster have been already reviewed in the July number of the NATURALIST.

Prof. Brooks has a short note on some interesting structures in the early stages of echinoderm larvæ. "Several observers have recorded the occurrence of a *right water pore* and pore canal, as well as those which occur normally on the *left* side, . . . but the former have heretofore been regarded as monstrosities. In the summer of 1889 I collected with a tow net, in the open waters of Wood's Holl, great numbers of normal, vigorous starfish larvæ; and upon studying their structure by serial sections I found that the water system is at first bilaterally symmetrical in every particular, although the right water pore and pore canal degenerate and disappear very early in the life of the larvæ, so that the older larvæ exhibit no traces of those structures. . . . . The phenomenon in question has a direct bearing upon the significance of the ciliated, bilateral swimming larva of Echinoderms,

and it furnishes a strong argument in favor of the view that the larva is ancestral."

Mr. Field published a contribution to the Embryology of Asterias. In this form the mesenchyme formation precedes and is continued during the process of invagination, confirming the view of Metschnikoff and Korchelt as to the absence of two "urmesenchymezellen" in the Echinoderms. The author agrees with Semon's recent paper on the formation of the adoral band. At the apex of the preoral lobe there is an ectodermic thickening comparable with the apical plate of Tornaria and Trochophore. The formation of a right water pore is described in detail, confirming Prof. Brooks's discovery and reaching the same conclusion that "the state with two bilaterally symmetrical water pores is a definite stage in the ontogeny of Asterias, and that it has a phylogenetic significance. The view that the bilateral larval form of the Echinoderms is ancestral, and not secondarily acquired, is gaining ground," and the author believes that the bilateral water pores may be homologous with a pair of nephridia. The later history of the Enterocœls is described.

ENTOMOLOGY.[1]

Entomology at Washington.—Three entomological societies met at Washington, in connection with the Association of Agricultural Colleges and Experiment Stations and the A. A. A. S., during the week of August 15th to 22d. These were the Section of Entomology of the Experiment Stations, the Association of Economic Entomologists, and the Entomological Club of the A. A. A. S. Besides these gatherings many papers upon entomological subjects were read before the Society for the Promotion of Agricultural Science and Section F of the A. A. A. S. Many entomologists were present at these meetings from various states, and the entomologists of Washington added greatly to the interest taken in these meetings.

Section of Entomology of Experiment Stations.—The opening session of this section was held on Saturday afternoon, August 15th, at the Columbian University, and consisted of a discussion of the proper duties of the entomologist of a station. Nearly all the members present held that so far as practicable but few subjects

[1] Conducted by Prof. C. M. Weed, Hanover, N. H.

should be investigated at a time, and that as soon as a subject had been thoroughly studied and the results and remedies published in a bulletin of the station, that particular investigation should be considered ended, unless future investigation brought to light some new points of importance. It was not considered the duty of a station entomologist to visit various parts of his state for the purpose of showing individual farmers how to handle insecticide machinery or how to destroy the locusts, after such a subject had been thoroughly explained in a station bulletin.

Many other subjects relating to station work were brought up and discussed. An election of officers resulted in the choice of Lawrence Bruner, of Nebraska, chairman, and F. M. Webster, of Ohio, secretary.

Monday evening Prof. A. J. Cook, of Michigan, read his report as chairman for the past year, before the Association of Agricultural Colleges and Experiment Stations. The report consisted of a résumé of the work done at the stations during the year, and that which is now in progress. Owing to the early date at which a report was called for, many of the stations had not reported; but from the reports obtained it is seen that the present season has been a most active one on the part of the station workers in entomology. The results obtained at the different stations were given, and the equipments of the stations were also described. In most of the stations the entomologist has some other department in charge, and in some cases teaches as well. The best combination shows itself when the entomologist has no other department of the station, but teaches entomology and perhaps zoology in the college connected with the station.

THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.—This association, while as yet very young, promises to become one of if not *the* foremost of its kind. Twenty-six working entomologists were present at the opening meeting on August 17th. Many new members were elected, some being corresponding members residing in foreign countries.

The opening address by Prof. James Fletcher, president of the association, was listened to with marked interest. Prof. Fletcher thought the entomologist should strive to popularize entomology as much as possible, in order that all might realize the importance of the subject from an economic standpoint as well as its possibilities, that all may see the beauties of the study of insects, even though "we don't eat them things."

Lawrence Bruner followed with an interesting paper upon "The Locust Appearances of 1891." Mr. Bruner had just returned from the western states, where the locusts are unusually abundant this year. It is feared that, unless prompt action is taken to destroy the eggs now being laid, many localities will be laid waste next year. Newspaper reports stated that railroad trains had been stopped by the locusts, and have implied that the locusts were so thick that the trains could not force their way through. The manner in which trains are stopped, however, has been by the crushing of a few hoppers upon the track, which so greased the rails as to stop the trains until sand was put upon the rails. In many of the localities infested local species have been found, although the migratory locust (*M. spretus*) was the most commonly distributed. Other species common are *M. brevitatus*, *M. atlantis*, and *D. longipennis*.

Mr. C. L. Marlatt read three short papers from C. H. Tyler Townsend, of New Mexico, upon some observations made in that region.

Prof. J. B. Smith followed with papers upon "Notes on Blackberry Borers and Gall Makers," and "The Melon Borer, *Melittia cucurbitæ*." Several points of interest were brought out.

Prof. Geo. F. Atkinson presented two papers: "A Cotton Cut-Worm," and "Note on a Nematode Leaf Disease." The case of the cut-worm upon the cotton was thought to be new.

Dr. D. S. Kellicott read a paper on "The Horn Fly in Ohio." He spoke of the appearance of this insect in Ohio and New York, and the probability as to the damage in the future.

Dr. C. V. Riley presented a paper on "Kerosene Combines with Pyrethrum." The origin and use of the so-called pyrethrum-kerosene emulsion was given. Many trials of this emulsion has proved it of but little value, and it does not merit the praise it has received.

Howard Evarts Weed followed with a paper on the "Work of the Season in Mississippi." The results of many experiments made during the season were given. *Hippodamia convergens* had been found feeding upon the cabbage, showing it to be an injurious insect. Screw worms (*Compsomyia macellaria*) have been abundant in some parts of the state during the year. Cattle at the station are kept free from ticks by feeding sulphur and salt in equal parts by keeping it before the cattle *all* the time. Cotton-leaf worms (Aletia) and boll worms (Heliothis) have so far appeared in but small numbers this season.

The secretary read a letter from Miss Eleanor A. Ormerod, of England, giving the results of Paris green experiments in England. Miss

Ormerod is a corresponding member of the association, and by her work had done much to popularize entomology in England.

Dr. C. V. Riley then presented two papers: "*Dermestes vulpinus* in Tobacco," and "Government Work *vs.* the Patent Office." The first paper dealt with a case of serious damage to a large cargo of tobacco while in shipment. It was thought the Dermestes had gained access to the tobacco while in shipment, and that it was not in the tobacco at the time of packing. The second paper presented the difficulties undergone by the Department of Agriculture owing to that department not having a lawyer to represent it in the courts. The hydrocyanic acid gas treatment for scale insects in California originated with the department, but a man not connected with the department has recently received a patent on the mere technicality of using the treatment at night. In the discussion which followed it was the opinion of most of the members that the patent would not be valid if brought up in the courts.

Prof. E. A. Popenoe, of Kansas, gave an account of a recent outbreak of *Dissostira longipennis* in that state. The outbreak has covered an extensive area, and much damage has been done.

Mr. M. H. Beckwith, of Delaware, presented some interesting "Notes on a Corn Crambid." In some localities much injury has been done.

Prof. J. B. Smith next presented two papers, one on "A Note on the Habit of *Saperda candida*," and the other, "Notes of the Year in New Jersey." The latter consisted of an account of the principal insects which have caused injury in New Jersey the present year.

Mr. L. O. Howard presented an interesting paper on "A Note on Parasites." Several new genera and species were exhibited.

Prof. Herbert Osborn presented a joint paper by himself and Mr. H. A. Gossard on "Experiments with the Hopperdozer for Grass-Leaf Hoppers." The paper gave the results obtained with this machine in Iowa this season. The hopperdozer was said to be an excellent agent in the destruction of the leaf hoppers.

Another paper, on "The Clover-Seed Caterpillar," by the same authors as the above, was read by Prof. Osborn. This insect has been very numerous at Ames this year, and has proved very injurious.

A paper upon "Notes of the Season in South Dakota" was read by the secretary from Mr. J. M. Aldrich Grasshoppers have appeared in large numbers in this state the present season, but by the constant use of hopperdozers many are killed, and fall plowing is practiced in order to kill the eggs.

Prof. Osborn gave the results of "An Experiment with Emulsions," in which it was thought the Hubbard formula was the best combination of soap, water, and kerosene.

At the meeting last year Mr. W. B. Alwood was appointed chairman of a committee to request the various force-pump manufacturers to use a standard fitting on spray machinery, in order that any nozzle will fit any pump. Entomologists and others who have had occasion to use spray machinery have had difficulty in using nozzles upon spray pumps other than the pumps made for the particular nozzle used. Mr. Alwood, in presenting his report, stated that most of the manufacturers had agreed to use a standard fitting for the spray nozzles manufactured by them. Correspondence with the manufacturers will be continued still further, and a printed report will soon be made, giving the arrangements made by the committee and the names of the manufacturers who have given their consent to the arrangements made by the committee.

The meetings of the association were held at the Columbian University the two days preceding the meeting of the A. A. A. S. The committee on nominations of officers presented its report as follows, which was adopted:

President, Dr. J. A. Lintner, of New York; first vice president, Dr S. A. Forbes, of Illinois; second vice president, Prof. J. H. Comstock, of New York; secretary, F. M. Webster, of Ohio.

Prof. Cook gave some interesting notes upon some parasites, and Mr. Wallace presented a paper upon silk culture. At the conclusion the association adjourned to meet next year on the Monday and Tuesday before the meeting of the A. A. A. S., and at the same place.

Entomological Club.—The Entomological Club of the A. A. A. S. held its meetings at the Columbian University, at Washington, August 19th to 22d. Many entomologists were present, and it was probably the largest meeting of entomologists ever held in this country. By an arrangement with the Association of Economic Entomologists papers relating to economic entomology were presented before this body, while those relating to life-histories and classification were presented before the club.

President's Address.—In his address as president of the club Herbert Osborn made several recommendations of much importance. One was the advisability of an international gathering of entomologists at the World's Columbian Exposition in Chicago in 1893. He also recommended that a manual of entomology be prepared.

The Encyrtinæ with Branch Antennæ.—Mr. L. O. Howard presented specimens and drawings of several species of this subfamily in which the antennæ were variously branched.

Insect Life in the Hot Springs of Yellowstone National Park.—This consisted of a letter to Mr. Schwarz from Mr. H. G. Hubbard, who is now collecting at the Yellowstone Park. Mr. Hubbard complained of the scarcity of species in this region.

Preliminary Notes on the Insect Fauna of the Great Salt Lake, Utah.—Mr. Schwarz presented many interesting notes upon the insect fauna of this region, especially Coleoptera.

Occurrence of the Pear Midge, Diplosis pyrivora.—Dr. Lintner gave an account of the appearance of this insect in various parts of New York.

Notes on the Pear Tree Psylla, Psylla pyricola. These notes were presented by Dr. Lintner, who also exhibited specimens.

Eye-Spotted Bud Moth in Western N. Y. Some of Our Orgygias.—These two papers were presented by Dr. Lintner. The first treated of *Tmetocera ocellana* in western New York, habits, and damage caused by this insect.

Habits of Xyleborus dispar and Volucella fasciata.—Mr. J. B. Smith presented two papers upon these insects. *Xyleborus dispar* has been quite injurious this season in New Jersey, and samples of the borings of this insect were presented.

Upon the Classification of Lepidoptera.—Prof. Smith is preparing a new list of this order, which will be out soon. Many changes have been made in the arrangement of the list from that of previous lists, and the reason for these changes were given. Prof. Smith also presented two papers upon "Revision of the Genus Cucullia," and "Staining Insect Structures."

Preserving Larvæ for Class Use.—Prof. E. W. Claypole spoke of the various means for preserving larvæ for study and illustration in collection.

A Substitute for Cork.—In this paper Prof. Claypole recommended cross-sections of soft woods as a substitute for cork. It seemed to be the general opinion of the entomologists present, however, that substitutes for cork did not pay, as specimens are more apt to be broken.

Natural Habitat of the Screw-Worm.—Prof. H. E. Weed presented observations upon this insect, which leads to the belief that its natural habitat is in dead flesh and decaying vegetable matter, rather than live animals, as is generally supposed.

The following papers were also read: "Two Borers Destructive to Mountain Ash," by Dr. D. S. Kellicott; "Bibliography of Entomology," by Mr. B. P. Mann; "Notes on *Sphecius speciosus*." "Some Interesting Phylloxeræ," by C. V. Riley; "Longevity of Ixodes and Trombidium," by Miss M. E. Murfelt; "Modification of Habit in Paper Wasps," by Miss Murfelt, showing that these wasps sometimes use paper already made instead of making it from wood.

The committee on recommendation of the president's address reported that a manual of entomology should be prepared, and recommended that specialists in the different orders be invited to prepare such a manual. The committtee was continued another year, with instructions to correspond with specialists in the different orders and publishers, to report at the next meeting of the club.

The following officers were elected for the ensuing year: President, E. A. Schwarz; secretary, F. M. Webster.

The following entomological papers were read before Section F of the A. A. A. S.: "Origin and Development of Parasitic Habit in Mallophaga and Pediculidæ," by Herbert Osborn; "The Origin and Development of Parasitism Among the Sarcoptidæ," by H. Garman; "On the Habits of the Proctotrypidæ," by Wm. H. Ashmead; "The Biology of the Chalcididæ," by L. O. Howard; "Parasitism in Coleoptera, in Diptera, in Braconidæ, and Ichneumonidæ," by C. V. Riley; "Microörganisms as Insecticides," by C. V. Riley; "Enemies of the Honey-Bee," by A. J. Cook; "Notes on the Homology of the Hemipterous Mouth," by John B. Smith; "Epipharynx and Hypopharynx of Odonata," by John B. Smith; "The Mouth of *Copris carolina*, and Notes on the Homology of the Mandible," by John B. Smith.

Before the Society for the Promotion of Agricultural Science the following papers were read: "Fighting the Rose Chafer," by A. J. Cook; "Bees and Fertilization," by A. J. Cook; "A Bacterial Disease of the Chinch Bug," by S. A. Forbes; "Northward Spread of a Tropical Injurious Insect," by L. O. Howard; "The Kerosene Emulsion and Its Increasing Usefulness," by C. V. Riley.—Howard Evarts Weed, *Agricultural College, Mississippi.*

ARCHEOLOGY AND ETHNOLOGY.

Proceedings of the Section of Anthropology (H) of the American Association for the Advancement of Science.—Washington, D. C., August 17–25, 1891.—The section held its first session in the Chemical Hall of the Columbian University on Wednesday, August 19th, at 2 P.M., Prof. Joseph Jastrow, of Madison, Wisconsin, vice president of the section, and Mr. W. H. Holmes, of Washington, D. C., secretary.

Vice president Jastrow's annual address was entitled "The Natural History of Analogy." He described the study of analogy in its bearings on various forms of culture, and went on to indicate that this form of argument is used only with great caution by societies of to-day. Analogy was, however, a very predominant method of argument amongst primitive people. The speaker defined analogy by speaking of instances of a further degree of resemblance from a given degree of resemblance. The various types of agreement differing slightly from the standard were also treated. In almost all savage customs and beliefs, the professor said, abundant instances of reasoning by analogy were to be found. In magical practices, in interpretations of omens and dreams, in medicinal practices, and social and tribal customs striking instances of analogous argument abounded. The Zulu who chews a bit of wood to soften the heart of the man he wants to buy an ox from; the fetish determining by whether a stick stands or falls whether a war shall be kept up or allowed to stop; the medicine man who performs incantations over some personal belonging of his victim or by the use of out-of-the-way drugs,—all these were instanced as the results of analogy or the feeling of analogy. Similar traits in children were described and illustrated. He said that an abundant field of illustration was found in the popular superstitions, folk lore, and customs that have survived from a lower to a higher culture. The modern dream book, household medicinal practices, charms, and, in the more elaborate system of details of astrology, the doctrine of sympathies, and kindred pseudo-sciences were the fields from which he took his illustrations. From this progressive scientific thought has reached its present place instead of the shifting position once occupied by the argument of analogy. "That which was serious reasoning to our forefathers," he said in conclusion, "now takes its place as a proper instrument for amusement and lies at the basis of a joke. This

offspring of our race is also connected by history with this earlier form, and, furthermore, close relation is traced between the bypaths of modern civilization and the outgrown forms of culture among which it originated."

The committee elected by the section were as follows: Fellow to the council, Rev. J. Owen Dorsey, Washington. Sectional committee, Prof. O. T. Mason, National Museum; Prof. Thomas Wilson, National Museum; Prof. George H. Perkins, University of Vermont. Member nominating committee, Prof. Thos. Wilson. Subcommittee on nominations, Prof. Paul Carus, editor *Monist;* Prof. C. P. Hart, Wyoming, Ohio; Mr. Walter Hough, National Museum.

The meetings for reading papers commenced Thursday morning, August 20th, at 10 A.M. Prof. W. H. Leaman delivered an address on "The Essentials of a Good Education, with a New Classification of Knowledge." Mr. Walter Hough gave a description of "The Custom of Kava-Drinking as Practiced by the Papuans and Polynesians," followed by Major J. W. Powell's exhibition of his new linguistic map of the Indians of North America.

This map is the *chef-d'œuvre* of the Bureau of Ethnology, and one in which Major Powell takes much pride. It represents many years of patient, careful labor of himself and some of his most valuable assistants. It has been presented before in rather an inchoate form to several scientific societies, but now it has been completed and will appear in the next volume of the reports of the Bureau of Ethnology. It attempts to represent the locality of the various Indian tribes of North America at the beginning of history. As the Atlantic coast was occupied by white men much earlier than the interior and the Pacific slope, so of course its representation on this map dates to an earlier time. Fifty-eight linguistic stocks or families are represented on the map, and these are divided into 264 dialects, representing as many different Indian tribes. The major said that over 1,000 Indian languages are spoken, which can be divided among seventy-five different stocks, and that while the number was large the tendency was not toward multiplication, but toward a unification or parent stock. He explained his system of segration and aggregation, and said that this map represented our earliest knowledge of the locations of Indian tribes in North America as shown by their language. It might require correction in the future, according as our knowledge of them might increase. In conclusion he made some humorous remarks on Volapük as a universal language, and compared it to the most barbaric of barbaric tongues, and that it approached closely primitive Indian tongues

of North America. He showed that civilized languages had little or no inflection, while the more primitive a language the greater the extremes of inflection, which is the case with Volapük. "To go to Volapük for a modern language would be like taking up the old wooden plow in agriculture again."

Mr. E. P. Vining, of St. Louis, Mo., criticised the map, disputed some of the propositions, and declared our knowledge of the Indian language of early times to be too indefinite and uncertain to form a foundation for so extensive a scheme of localization.

Dr. Thomas Wilson presented a collection of fifty or more of gold ornaments from his department of prehistoric archeology in the National Museum, taken from prehistoric graves chiefly in the province of Antioquia, United States of Colombia, lately procured; also a series of prehistoric jade implements from Mexico and Central America. All of them were beautifully wrought, and many of them had been sawed into two or more parts, and holes drilled for suspension as for amulets. Dr. Wilson said these were one of the varieties of jade called jadeite, the component parts of which were silica 59.4, alumina 25.8, soda 15.3. He described other varieties of jade,—nephrite, which was silica, magnesia, lime; fibrolite, silica and alumina; pectolite, silica, lime, and soda; and said pectolite was local in Arizona and New Mexico, implements made of it in prehistoric times being found among the ruins of the cliff dwellers of those territories. Nephrite was local in Alaska and British Columbia, where the wrought implements were found belonging to both historic and prehistoric times. These jadeite implements were confined to Mexico and Central America, though none of the raw material had been found nearer than New Zealand and the Asiatic coast. On this, with some addition, he said Prof. Putnam had founded the theory of the migration of the Central American and Mexican aboriginal population from Asia. If the theory be true, he did not believe that it had been, as claimed, by way of Behring Strait, because throughout the length of the continent no trace of such a passage had been found. On the contrary, similar implements made of a different material coming from the Yukon and other rivers had been found for a thousand miles over this route between Behring Strait and Mexico. Prof. Morse called on Prof. Putnam (who had just come in), and he expanded his theory, which in turn was attacked by Major Powell, who prophesied that jadeite would yet be discovered in that country. Prof. Putnam replied when it was there would be time enough, etc.

Rev. J. Owen Dorsey read a paper, and described, with charts, some of the peculiarities and phonetic types of the Siouan language.

Mrs. Anita Newcomb McGee read a paper entitled "An Experiment in Human Stirpiculture."

"It is not generally known that a carefully planned and methodically conducted experiment in human stirpiculture, probably the most extensive and systematic of modern times and civilized people, was carried on during the years 1808 to 1879 in Central New York. The originator of the experiment was a zealous but logical enthusiast, the late John Humphrey Noyes; the purpose was the promotion of sanctity; the place and the means were the Oneida community.

"In early life Noyes founded the peculiar sect called perfectionists, which in 1848 gathered disciples to the number of eighty-seven at Oneida. Here the community of goods and also of person was practiced, a system of complex marriage in which the amative and propagative functions were separated having been established.

"Until 1868 the birth-rate in the community was carefully limited, but at this date, financial success being assured and the members having increased to 250, the experiment in stirpiculture was begun. Its object was the increase of sanity in succeeding generations in order that sin, disease, and finally death might be abolished. Physique, intellect, hereditary qualities, mutual attraction, etc., were secondarily considered.

"The first principle of this stirpiculture was continued in and in breeding with judicious mixture of foreign blood from time to time. Its second principle was the careful selection of individuals. From 1869 to 1880 sixty children were born in pursuit of this plan. Of these five died at birth from unforeseen causes depending on the mothers, and one child was acknowledged a failure physically. Otherwise the experiment was progressing admirably, the children being given the best of care, when an unexpected result caused the failure of all Noyes's plans. The spirit of monogamy, ruthlessly kept in check before, became so strong in consequence of the mating of one-quarter of the community for stirpicultutal purposes that the complex marriage system was given up in 1879. The dissolution of the Oneida commûnity by mutual consent followed a year later. Noyes, foreseeing the end, had retired from Oneida, and died in 1886.

"Of the stirpicultural children only one has since died. The others, now aged eleven to twenty-two years, are on the whole somewhat above the outside average in physique and intellect. The blood of the children came largely from farmers and mechanics, with a

strong infusion from the intellectual Noyes family. It is therefore noteworthy that of the oldest sixteen boys ten are in business as clerks, foremen, etc., one is a musician of repute, two are students of law and medicine, two at college, and only one following a manual occupation, being a mechanic. Of the oldest six girls, two are at college and one is a student of the kindergarten system."

Mrs. Zelia Nuttall's paper on "Relics of Ancient Mexican Civilization" was, in her absence, read by Prof. Putnam. It described many Mexican antiquities, and threw a great deal of light on the civilization of ancient Mexico. The paper was illustrated with a number of small reproductions of Aztec ornamental designs, and of a chief's shield sent to Italy by Cortez, the only thing of the kind known to anthropologists, which were collected by the distinguished lady. One of the drawings she presented represented four peculiarly horrible-looking Aztec gods.

Prof. Edward S. Morse, of Salem, read two very clever papers on the allied subjects of "Bow Stretchers" and "Prehistoric Bows." The first of these papers referred to the puzzling little bronze implements found associated with Roman antiquities. The professor exhibited one of them. They are usually a couple of inches long, with three spurs of varying size and shape on one side, the ends of the main portion of the implement being two rings large enough to allow a man's fingers to be thrust through. They have always been called bow stretchers on the supposition that prehistoric archers used them in drawing back the strings of their powerful bows; but Prof. Morse pointed out the fallacy of such a conclusion, and showed the impossibility of their being so used. What the little affairs were used for by prehistoric man is, and may always be, a conundrum to the world's anthropologists. Incidentally Prof. Morse described the way various nations held and drew the bow-string, and said that in China the archer of to-day shoots his arrow by hooking his thumb around it, his thumb being protected by a peculiar ring, just like an immeasurably ancient bronze ring that the professor had got from prehistoric graves that dated back to the bronze age of man. His second paper, on "Prehistoric Bows," showed the great simplicity and similarity of the prehistoric bows found in Peru, Egypt, the peat bogs of Denmark, Holland, the Swiss lake villages, and other places.

"The Nez Perce Country," written by Miss Alice Fletcher, was read by Mrs. Barnes. This paper was an explanation of a map of the Nez Perce country, drawn by a native of the tribe, and showing the location of seventy-eight villages, and giving the Nez Perce names of mountains

and streams. A summary of the dimensions and groups of these villages was given and an outline of the tribal organization, with a brief account of the mode of living in the village and some deductions concerning the relation of the environment to the development of the people. A short biographical sketch of the Indian who made this map was also given and his photograph shown.

Dr. Wilson told of his connection with the Nez Perce tribe of Indians in his endeavor to recover possession of the land now occupied by the Lapwaii reservation for the benefit of the A. B. C. F. M. (foreign missions), who had sent the first missionaries to that country before it became the property of the United States, and who had by their possession materially aided in making it such. The title of the board to the 640 acres, one mile square, was, he said, as good as that of any person in Washington to the house in which he lived; but they had never been able to get possession.

Mr. Frank Leverett, of Madison, Wisconsin, described by means of maps and charts the "Relation of the Loveland, Ohio, Implement-Bearing Terrace to the Moraines of the Ice Sheet."

"The Utility of Physical Study of Child Life" was next presented by Mrs. Laura Osborne Talbott. If "the child of to-day is to become the man of to-morrow," is not the responsibility of the present generation great regarding the civilization of the coming century? No thoroughly philosophical study has taken up the subject of child life at a sufficiently early period; the school laws do not permit a child to enter the public school before the age of six years. This is the most important period of a child's life, as its acquired perceptions then are most numerous, its inherited tendencies become fixed, and the creative power of the brain is most easily awakened. From the time that consciousness begins to unfold there is begun a series of acts that might engage the attention of psychical experts whose duty it would be to watch every indication of development for good or for evil. No crude management is required for child life, but teachers of rarest gift, whose tact, discernment, and wisdom will best assist in bringing forth from the embryo the fully rounded and complete being. Comcnius, Pestalozzi, and Froebel have, in their philanthropic labors, conferred great benefits upon mankind, yet deeper insight into the child's mind is demanded than has been afforded by them. The demand of the age is for more creative power, or for an intellectual force that may be able to harmonize the different elements of our civilization. All questions arising from the mixed conditions of our present civilization must eventually revert to the final question, How can we best develop all the

energies of the individual? According to Herbert Spencer, "the process in which life essentially consists is the continuous maintenance of an equilibrium between the organism and its environment." It is evident that this want of equipoise or correspondence between the inner and outer life of the individual causes great failures in life. For ages the human race has been a prey to every variety of crime, and nations have risen only to fall into degradation. The same fate is before us unless we give to each child its inalienable right to develop its whole nature to its highest power of development. What an uplifting to all civilization would take place in a few generations if a truly wise and philosophical training could be given to young children in order rightly to stimulate their mental and moral powers. There are families who for many years have given great attention to this important subject, but there has been no general movement toward this object. From an economical standpoint it might by wise to endeavor to uplift the masses in this manner, for the ancients teach us that one member cannot suffer injury without danger to the whole body.

The paper on the "Origin of the Name Chautauqua," by Albert S. Gatschet, stated at length the linguistic reasons why this name, which is worded on the Seneca-Iroquois language still spoken in Western New York, cannot signify anything else but "one has taken out fish there." It is pronounced by these Indians T'kan Tchatak Wan, and the old English and French documents vary enormously in their mode of writing it. It is probable that fish were taken out by the Indians from Lake Chautauqua to stock the brooks and ponds of the vicinity. The author proposes to change the orthography of Chautauqua into the more scientific Chatakwa.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Association for the Advancement of Science.—The fortieth meeting of this body met in Washington, D. C., from August 19th to 25th, inclusive. The officers were: *President*, Albert B. Prescott, Ann Arbor, Mich. *Vice Presidents*, (A) Mathematics and Astronomy—E. W. Hyde, Cincinnati, Ohio; (B) Physics—F. E. Nipher, St. Louis, Mo.; (C) Chemistry—R. C. Kedzie, Agricultural College, Mich.; (D) Mechanical Science and Engineering—Thomas Gray, Terre Haute, Ind.; (E) Geology and Geography—J. J. Stevenson, New York; (F) Biology—J. M. Coulter, Bloomington, Ind.; (H) Anthropology—Joseph Jastrow, Madison, Wis.; (I) Economic Science and Statistics—Edmund J. James, Philadelphia, Pa. *Permanent Secretary*, F. W. Putnam, Cambridge (office, Salem), Mass. *General Secretary*, Harvey W. Wiley, Washington, D. C. *Secretary of the Council*, Amos W. Butler, Brookville, Ind. *Secretaries of the Sections*, (A) Mathematics and Astronomy—E. D. Preston, Washington, D. C.; (B) Physics—A. Macfarlane, Austin, Texas; (C) Chemistry—T. H. Norton, Cincinnati, Ohio; (D) Mechanical Science and Engineering—William Kent, New York, N. Y.; (E) Geology and Geography—W. J. McGee, Washington, D. C.; (F) Biology—A. J. Cook, Agricultural College, Mich.; (H) Anthropology—W. H. Holmes, Washington, D. C.; (I) Economic Science and Statistics—B. F. Fernow, Washington, D. C. *Treasurer*, William Lilly, Mauch Chunk, Pa.

WEDNESDAY, AUGUST 19TH.—In the afternoon the chairmen of the sections delivered their addresses. Prof. Stevenson, of Section E, spoke "On the Relations of the Chemung and Catskill on the Eastern Side of the Appalachian Basin." Prof. Coulter, of Section F, spoke "On the Future of Systematic Botany." The subject of the address of Prof. Jastrow, of Section H, was "The Natural History of Analogy." In the evening the retiring president, Prof. G. L. Goodale, delivered an address "On the Possibilities of Additions to our Cultivated and Useful Plants from New Sources."

The papers read in Sections E, F, and H were as follows:

THURSDAY, AUGUST 20TH.—*Section E.*—Source of Supply to Lateral and Medial Moraines, John T. Campbell. New Meteoric Iron from Arizona Containing Diamonds, A. E. Foote. Post-Glacial Anticlinal Ridges near Ripley and Caledonia, N. Y., G. K. Gilbert. Purposes of

Mountain-Building and Their Relationship to the Earth's Construction, Warren Upham. Notes on an Extinct Volcano at Montreal, Canada, Henry Lampard. On a New Horizon of Fossil Fishes, E. D. Cope. On the Cranial Characters of *Equus excelsus* Leidy, E. D. Cope. On Problematic Organisms and the Preservation of Algæ as Fossils, Joseph F. James. On the Age of the Mount Pleasant, Ohio, Beds, Joseph F. James. Preliminary Report of Observations at the Deep Well near Wheeling, W. Va., William Hallock. The Eureka Shale of Northern Arkansas, T. C. Hopkins.

Section F.—Notes on the Physiological and Structural Changes in Cayuga Lake Lampreys, Simon H. Gage. Notes on the Heart of Certain Mammals, Ida H. Hyde. The Transformation of the Vermilion-Spotted Newt, Simon H. Gage. On the Kinds of Motion of the Ultimate Units of Contractile Living Matter, John A. Ryder. On the Extinction of the Scapular and Pelvic Arches and Limbs of Lacertilia, E. D. Cope. On the Structure and Dimorphism of *Hypocrea tuberiformis*, Geo. F. Atkinson. Another Chapter in the History of the Venus Fly Trap, J. M. Macfarlane. On the Prothallium and Embryo of *Osmunda claytoniana* and *O. cinnamomea*, Douglas H. Campbell. A New Nectria, Byron D. Halsted. The Compositæ Collected by Dr. Edward Palmer in Colima, Joseph N. Rose. The Flora of Carmen Island, Joseph N. Rose. Uses of the Fermentation Tube in Bacteriology, with Demonstrations, Theobald Smith. The Foraminifera, with a New Device for the Exhibition of Specimens, James M. Flint.

Section H.—The Essentials of a Good Education, with a New Classification of Knowledge, Wm. H. Seaman. The Custom of Kava-Drinking as Practiced by the Paquans and Polynesians, Walter Hough. A Linguistic Map of North America, J. W. Powell. Jade Implements from Mexico and Central America, Thomas Wilson. Gold Ornaments in the United States National Museum from the United States of Colombia, Thomas Wilson. Siouan Onomatopes Interjections and Phonetic Types, J. Owen Dorsey. On a Collection of Stone Pipes from Vermont, G. H. Perkins. The Importance and Methods of the Science of Comparative Religion, Merwin Marie Snell.

FRIDAY, 21ST.—*Section E.*—Fossil Tracks in the Triassic of York county, Pa., A. Wanner. New Footprints of the Connecticut Valley, M. N. Mitievier. The Plant-Bearing Deposits of the American Trias, Lester F. Ward. A Reply to Professor Marsh's Note on Mesozoic Mammalia, Henry F. Osborn. Principles and Methods of Geologic Correlation by Means of Fossil Plants, Lester F. Ward. Exhibition of

Certain Bones of Megalonyx Not Before Known, James M. Safford. On the Probable Existence of a Second Driftless Area in the Mississippi Basin, R. D. Salisbury. The Cincinnati Ice Dam, Frank Leverett. The Structure of the Ouachita Uplift of Arkansas, Leon S. Griswold. The Relations of the Archean and the Algonkian in the Northwest, C. R. Van Hise. Results of a Well-Boring at Rochester, N. Y., Herman L. Fairchild.

Section F.—A Monograph of the Carolina Paroquet, Edwin M. Hasbrouck. Notes on Bacteria of Cucurbits, Byron D. Halsted. On Coloration in Certain Reptilia, E. D. Cope. Transpiration or the Loss of Water in Plants, Chas. E. Bessey and Albert F. Woods. Movements of Fluids in Plants, Wm. J. Beal. Absorption of Fluids by Plants, L. H. Pammel. Gases in Plants, J. C. Arthur. Notes Upon an Anthracnose, Byron D. Halsted. Origin and Development of Parasitic Habit in Mallophaga and Pediculidæ, Herbert Osborn. The Origin and Development of Parasitism Among the Sarcoptidæ, H. Garman. On the Habits of the Proctotrypidæ, Wm. H. Ashmead. The Biology of the Chalcididæ, L. O. Howard.

Section H.—An Experiment in Human Stirpiculture, Anita Newcomb McGee. Relics of Ancient Mexican Civilization, Zelia Nuttall. Bow Stretchers, Edward S. Morse. Prehistoric Bows, Edward S. Morse. The Nez Perce Country, Alice C. Fletcher. Relation of a Loveland, Ohio, Implement-Bearing Terrace to the Moraines of the Ice Sheet, Frank Leverett. Utility of Psychical Study of Child Life, Laura Osborne Talbott. Origin of the Name Chautauqua, Albert Gatschet.

SATURDAY, 22D.—*Section E.*—The Attitude of the Eastern and Central Portions of the United States During the Glacial Period, T. C. Chamberlin. Neocene and Pleistocene Continent Movements, W. J. McGee. Results of a Well-Boring at Rochester, N. Y., Herman L. Fairchild. On a Deep Bore near Akron, Ohio, E. W. Claypole. The Relations of the Archean and the Algonkian in the Northwest, C. R. Van Hise. A Study of the Fossil Avifauna of the Silver Lake Region, Oregon, R. W. Shufeldt. The Peninsula and Volcano Cosignina, J. Crawford. The Geological Survey of Nicaragua, J. Crawford. The Highest Old Shore Line on Mackinac Island, F. B. Taylor. Striæ and Slickensides at Alton, Illinois, J. E. Todd.

Section F.—Parasitism in Coleoptera, in Diptera, in Braconidæ, and Ichneumonidæ, C. V. Riley. Microörganisms as Insecticides, C. V Riley. Enemies of the Honey Bee, A. J. Cook. Notes on the Homology of the Hemipterous Mouth, John B. Smith. Epipharynx

and Hypopharynx of Odonata, John B. Smith. The Mouth of the *Copris carolina*, and Notes on the Homology of the Mandible, John B. Smith. On the Phylogeny of the Archegoniata, Douglas H. Campbell. On the Turtles of the Genus Malaclemys, O. P. Hay. The President Condition of the Study of the Deep-Sea Fishes, G. Brown Goode. On the Injection of Blood from the Eyes of Horned Toads, O. P. Hay. Abnormal Bees, A. J. Cook. On the Importance of a Table at the Naples Station, Chas. W. Stiles. Further Observations on a Bacterial Disease of Oats, B. T. Galloway. Botanical Field-Work of the Botanical Division, George Vasey. Results from Recent Investigations of Pear Blight, M. B. Waite. The Spectroscope in Botanical Studies, I. S. Brashear. The Persistence and Relation of Faunal Realms, Theodore Gill. The New Zealand Fish Fauna, Theodore Gill. A Case of the Loss of Sense of Smell, Joseph Jastrow. A Novel Color Illusion and a New Method of Color Mixture, Joseph Jastrow. Modification of Habit in Paper-Making Wasps, Mary E. Murtfeldt. The Fate of the Fur Seal in American Waters (lantern illustrations), Wm. Palmer.

Section H.—An Ancient Human Cranium from Southern Mexico, F. W. Putnam. The Length of a Generation, C. M. Woodward. Burial Customs of the Hurons, Chas. A. Hirschfelder. The Messiah Religion and the Ghost Dance, James Mooney. Study of a Dwarf, Frank Baker. Stone Drills and Perforations in Stone from the Susquehanna River, Atreus Wanner. Evidences of the High Antiquity of Man in America, Thos. Wilson. On Bone, Copper, and Slate Implements Found in Vermont, G. H. Perkins. Some Archeological Contraventions, Gerard Fowke. On the Distribution of Stone Implements in the Tide-Water Province, W. H. Holmes. Aboriginal Novaculite Quarries in Arkansas, W. H. Holmes. Games of Teton Dakota Children, James Owen Dorsey. Geographical Arrangement of Prehistoric Objects in the U. S. National Museum, Thos. Wilson. Curious Forms of Chipped Stone Implements Found in Italy, Honduras, and the United States, Thos. Wilson. Inventions of Antiquity, Thos. Wilson. Study of Automatic Motion, Joseph Jastrow. Race Survivals and Race Mixture in Great Britain, W. H. Babcock.

Excursions.—On Saturday, Sunday, Monday, and Tuesday the following excursions were proposed for the association: To Luray, Va. (expense, $7.50); to Atlantic City; Norfolk, and Virginia Beach, Va. (expense, $8.00); Baltimore ($2.00); Mount Vernon, Va. On account of the expense, some of these excursions were not or but little patronized. This was a unique feature in the history of the American Association.

On the evening of Friday the 21st, Prof. John M. Macfarlane, of Edinburg, delivered an address consisting of "Illustrations of Heredity in Plant Hybrids," which was illustrated by enlarged views of plant cell structures thrown on a screen.

At the conclusion of the lecture the council met and elected the following officers for 1892:

President, Prof. Joseph LeConte, of the University at Berkeley, Cal.; permanent secretary, Prof. F. W. Putnam, Cambridge, Mass.; general secretary, Prof. Amos W. Butler, Brookville, Ind.; council secretary, Prof. T. H. Horton, of Cincinnati University; and treasurer, William Lilly, Mauch Chunk, Pa. The vice presidents of sections number: A, Prof. J. R. Eastman, of the Naval Observatory, Washington; B, Prof. B. F. Thomas, State University, Columbus, Ohio; C, Dr. Alfred Springer, Cincinnati; D, Prof. J. B. Johnson, Washington University, St. Louis; E, Prof. H. S. Williams, Cornell University; F, Prof. S. H. Gage, Cornell University; H, W. H. Holmes, of the Ethnological Bureau; and I, Prof. S. Dana Horton, Pomeroy, Ohio.

Dr. H. Wheatland, of Salem, Mass., and Mr. Thomas Meehan were chosen auditors, and the following gentlemen will be the new secretaries of sections:

A, Prof. Winslow Upton, Brown University, Providence, R. I.; B, Prof. Browne Ayers, Tulane University, New Orleans; C, Prof. J L. Howe, Louisville Polytechnic Institute; D, Prof. O. H. Landreth, Vanderbilt University; E, Prof. R. D. Salisbury, University of Wisconsin; F, Prof. B. D. Halsted, Rutgers College, New Brunswick, N. J.; H, Dr. Stewart Culin, Philadelphia; and I, Lester F. Ward, of the Geological Survey, Washington.

The council was in receipt of a hearty invitation to select Rochester, N. Y., as the place of the next convention, and a ballot resulted in the choice being made.

A general session was held on the evening of Tuesday, August 25th, when the above officers and place of meeting were chosen for 1892. An invitation to meet in Chicago during the exposition in 1893 was presented by a Mr. Young in a speech commensurate with the anticipated grandeur of the event. Resolutions of thanks to the various entertaining bodies and authorities were adopted.

The Geological Society of America.—This organization commenced its session August 24th in the Columbian University building, Washington, D. C., and closed it on the evening of August 25th.

Owing to the death of the president, Prof. Alex. Winchell, the vice president, Mr. G. K. Gilbert, took the chair.

In opening the meeting the acting president, Mr. G. K. Gilbert, made a few brief remarks, in which he welcomed the society to Washington, and, in the name of President Welling, to the university. A touching memorial of the deceased president of the society, Alexander Winchell, was read by Prof. N. T. Winchell, brother of the deceased. The paper gave a sketch of the life and work of Prof. Winchell, and was a fitting tribute to a man who occupied his high position among geologists.

The following papers were read:

MONDAY, AUGUST 24TH.—A Geological Map of South America, Prof. Dr. Gustav Steinmann, University of Freiburg, Germany. On the Permian, Triassic, and Jurassic Formations in the East Indian Archipelago (Timor and Rotti), Dr. August Rothpletz, University of Munich, Germany. Thermometamorphism in Igneous Rocks, Mr. Alfred Harker, St. John's College, Cambridge, England. The Lower Silurian (Ordovician) Ichthyic Fauna, and Its Mode of Occurrence, C. D. Walcott. Relations of the Plant-Bearing Deposits of the American Trias, Lester F. Ward. Studies in Problematic Organisms: The Genus Scolithus, Joseph F. James. The Tertiary Iron Ores of Arkansas and Texas, R. A. F. Penrose, Jr. Contribution to the Geology of the Plains, Sandstone Dikes in Northwestern Nebraska, Robert Hay. Some Recent Experimental Reproductions of Scottish Mountain Structures, Henry M. Cadell, Esq., Scotland. Mechanics of Appalachian Structure (with lantern illustrations), Bailey Willis.

TUESDAY, AUGUST 25TH.—The Relations of the Fossil Echinoid Faunas of Europe and America, Mr. John Walter Gregory, British Museum, London, England. On the Eurypterus Beds of Oesel as Compared with Those of the Waterlime of North America, Dr. Friedrich Schmidt, Academy of Sciences, St. Petersburg, Russia. Sur les Couches Marines Terminant le Jurassique et Commençant le Crétace et sur l'Histoire de leur Faune, Prof. Alexis Pavlow, University of Moscow, Russia. Sur l'Homme Contemporain du Mammouth en Belgique, Prof. Max Lohest, University of Liége, Belgium. On the Quaternary Changes of Level in Scandinavia, Baron Gerald de Geer, State Geologist, Stockholm, Sweden. The Black Earth of the Steppes of Southern Russia: Its Origin, Distribution, and Points of Resemblance With the Soils of the American Prairies, Prof. A. Krassnof. Sur l'Existence du Dinotherium en Roumaine, Prof. Gregoire Stefanescu, University of Bucharest, Roumania. The Present Standing of

the Several Hypotheses of the Cause of the Glacial Period, Thomas C. Chamberlin. On the Northward and Eastward Extension of Pre-pleistocene Gravels in the Basin of the Mississippi; On Certain Extra Morainic Drift Phenomena of New Jersey, R. D. Salisbury. Inequality of Distribution of the Englacial Drift, Warren Upham. Defloration and Deformation of Alluvial Deposits in New England, Homer T. Fuller. The Elæolite Syenite of Beemerville, N. Y., J. F. Kemp. On the Separation and Study of the Heavy Accessories of Rocks, Orville A. Derby. Contributions to the Areal Geology of the Texas-New Mexico Region: (*a*) The Tertiary History of the Rio Grande Embayment; (*b*) The Llano Estacado and Edwards Plateau; (*c*) The Basin Formations of New Mexico, and Accompanying Volcanic Craters; (*d*) The Las Vegas Raton Plateau, R. T. Hill. The Missouri Coal Measures and the Conditions of their Deposition, Arthur Winslow. The Well's Creek Basin and Uplift in Stewart and Houston Counties, Tennessee; The Pelvis of the Megalonyx, and the Lot of Undescribed Bones Among which It is Found, from Big Bone Cave, in Tennessee, James M. Safford. The Cienegas of Southern California; A Description and Discussion of Their Geological Structure and Origin, E. W. Hilgard. Notes on the Crystalline Rocks of Central Texas, with Maps, T. B. Comstock. On a Deep Boring near Akron, Ohio, and Its Significance, E. W. Claypole. The Natural Bridges of Florida and the Chattahoochee Embayment, Lawrence G. Johnson. On Some Peculiar Causes which are Influencing Topographical Changes and Geological Formations in the Channel Islands of California, Lorenzo G. Yates.

The International Geological Congress.—This body met in the Columbian University, Washington, D. C., from August 26th to September 2d, inclusive. The officers of the meeting were: Honorary presidents, J. D. Dana, James Hall. President, J. S. Newberry. Vice presidents—United States, Joseph Le Conte, J. W. Powell, and Raphael Pumpelly; Canada, J. C. K. Laflamme and W. Macfarlan; Mexico, A. del Castillo; England, T. McK. Hughes; Scotland, H. M. Cadell; France, A. Gaudry and Charles Barrois; Belgium, E. Van den Broeck; Holland, G. A. F. Molengraaff; Norway, H. Reusch; Sweden, Gerard de Geer; Russia, Th. Tschernychew, F. Schmidt, and A. Pavlow; Denmark, Dr. Johnstrup; Germany, Dr. Von Zittel and H. Credner; Austria, Dr. E. Tietze; Hungary, Joseph Von Szabo; Spain, M. F. de Castro; Portugal, Joaquin Filippe Nery Delgado; Italy, Prof. G. Uzielli; Switzerland, H. Golliez;

Roumania, G. Stefanescu; India, F. R. Mallet; New Zealand, F. Hutton; Australia, Arch. Liversidge; Chili, F. J. San Roman. General Secretaries, H. S. Williams, S. F. Emmons. Secretaries, J. C. Branner, Emm. de Margerie, G. H. Williams, Dr. F. Frech, Dr. Diener, Whitman Cross. Treasurer, Arnold Hague.

Owing to the illness of Prof. Newberry the chair was taken by Prof. T. McKenna Hughes, of England; Prof. Karl Von Zittel, of Munich; Prof. Albert Gaudry, of Paris; and by Prof. Joseph LeConte, first vice president. Prof. Hughes made the opening address, and was succeeded by the Hon. Gardner C. Hubbard, of Washington, in an address of welcome from the city. On behalf of the president and the government Hon. J. S. Noble, Secretary of the Interior, delivered an address of welcome, which was followed by a few remarks from Major J. W. Powell.

The program of proceedings was as follows:

WEDNESDAY, AUGUST 26TH.—10 A.M., meeting of the council for nomination of bureau. 2 P.M., opening of the congress, election of bureau, addresses, etc. 9 P.M., reception at the Arlington Hotel by the Geological Society of America.

THURSDAY, AUGUST 27TH.—10 A.M., meeting of the council. 11 A.M., morning meeting of congress. 2.30 P.M., afternoon meeting of congress. Evening reception by Mr. and Mrs. S. F. Emmons, at 1725 H Street, 10 P.M., and by Mr. and Mrs. Thomas Wilson, 1218 Connecticut Avenue.

FRIDAY, AUGUST 28TH.—10 A.M., meeting of council. 11 A.M., morning session of congress. 2.30 P.M., afternoon session of congress. Evening, the National Museum was opened to members of the congress.

SATURDAY, AUGUST 29TH.—10 A.M., morning session of congress. Afternoon, no special program made.

MONDAY, AUGUST 31ST.—10 A.M., meeting of council. 11 A.M., morning session of congress. Evening, 9 to 11, reception by the director and members of the Geological Survey at 1330 F Street.

TUESDAY, SEPTEMBER 1ST.—10 A.M., meeting of council. 11 A.M., closing session of congress. Afternoon, excursion on the Potomac, on steamer furnished by the committee, and dinner at Marshall Hall.

It had been recommended by the managing committee that the discussion open on the following topic:

I. Time correlation of the clastic rocks.
 1. Correlation by structural data.
  a. By stratigraphical data.
  b. By lithological data.
  c. By physiographical data.
 2. Correlation by paleontological data.
  { *a*. By fossil plants, { *a*. By marine fossils.
  or
  { *b*. By fossil animals, { *b*. By terrestrial fossils.

II. General geological color schemes and other graphic conventions.

III. Genetic classification of the Plistocene rocks.

The consideration of the first division of the above plan was taken up by the presentation of a synopsis of the subject by Prof. G. K. Gilbert. The third part of the subject was opened by the presentation of two systems of glacial phenomena, one by President Chamberlin and the other by Mr. W. T. McGee. The discussion was as follows:

Prof. Gaudry spoke as follows: In the Parisian basin there are two different horizons distinguished by different faunas, the one indicating a cold, the other a warm climate. It is, however, impossible to decide which of these two periods was the earlier. In England the same condition of affairs is to be observed. In Germany there is but one Quaternary fauna, which indicates a cold climate, whilst in Italy the fauna of the cold period is absent.

Prof. H. Credner: The North German plain contains deposits closely related to those of the Plistocene in America. Prof. Chamberlin's classification is admirable and wholly applicable to Germany.

Baron de Geer expressed his approbation of the classification proposed by Prof. Chamberlin. He had for some years been advocating a similar classification for Scandinavia. A few minor alterations might be suggested to suit Scandinavian conditions; for instance, the marine deposits might be made a separate class; classes IV. and V. of Prof. Chamberlin could, perhaps, be reduced to subclasses under III., as the formations frequently seem to be accidental or local. He agreed with the distinction suggested between osars and kames,—that is, that the former are in the main radial and the latter peripheral with reference to the distribution of land ice.

Prof. T. McK. Hughes pointed out that the classification given by Prof. Gaudry was purely chronological, whereas that suggested by Prof. Chamberlin was purely genetic. He then explained the abundance of striated boulders in one part of the glacial deposits and their absence in another. If the supply of material (that is, of rock bosses

above the ice) ceases at any point, then all the boulders will gradually sink through the ice and become glaciated at the bottom. Prof. Hughes also thought that two distinct types of ridges formed of glacial material were confused under the names kames, osars, and eskar. He also explained that "pitted plains" as due to an unusual interruption between the hills or ridges of eskar character. He expressed his opinion that the Glacial period was a continuous one, in England at least, except for slight changes due to unimportant oscillations.

Dr. Wahnschaffe advocated the chronological classification, and considered such a one possible for the Quaternary deposits of North Germany. These deposits begin with pre-Glacial sands and gravels containing *Paludina diluviana*, which is still a living form, and *Lithoglyphus naticoides*. Above these follows a typical ground moraine, which is overlaid by stratified sand and gravel, containing the well-known diluvial fauna; and to these again succeeds the upper till, considered now as the ground moraine of the second glacial epoch.

Prof. H. Credner: The occurrence of the sand between two ground moraines indicates a retreat and second advance of the ice sheet. Such interpolated sands are in Germany always local, and no proof of a real interglacial epoch. The sand layers between the moraines are not continuous, but local, and cannot be given the significance attributed to them by Wahnschaffe.

Prof. Pavlow: In order to secure a satisfactory classification of Quaternary deposits, we must secure a satisfactory definition of Pleistocene. Prof. Pavlow said he would like to give his own views, but would postpone them until such accepted definition had been arrived at.

Baron de Geer agreed with Wahnschaffe that the chronological classification is at least locally possible. He also recognized two glacial epochs, due to two great oscillations. These cannot always be separated, as, for instance, in Russia. For this reason it is best to commence with a genetic classification, since this causes less confusion to the field geologist.

Dr. Wahnschaffe replied to Prof. Credner's assertion that there is no proof of an interglacial period in Northern Germany. He that that the existence of a diluvial fauna between the two tills is sufficient proof.

Prof. Credner replied that no complete skeleton had been found, but only single bones which might have been transported and deposited with the gravel.

Dr. Wahnschaffe again replied that the bones occurring in these gravels are proportionately large, when compared with the gravels

themselves, and therefore cannot well have been transported from a distance.

Prof. Shaler: Organic deposits may possibly occur very near the ice sheet, which allows an interweaving of organic and glacial deposits.

Mr. G. K. Gilbert remarked on the observation of I. C. Russel in Alaska, that where the movement of the ice is very sluggish it may become covered with soil, or even with a growing forest, in which such animals as bears still live.

Dr. Diener remarked that intercalated beds of sand were no positive proof of interglacial periods. In the Austrian Alps moraines no more than twenty years old are covered with pasture, and in the Caucausas the rhododendron grows to the very edge of the ice.

Dr. Holst mentioned two moraines separated by interpolated sand, and thought that they might both have been formed by the same ice sheet. The melting of the ice leaves un unoxidized (blue) ground moraine, with an overlaying oxidized (yellow) upper moraine. This also occurs in Northern Sweden, where there is no indication of a retreat of the ice.

Baron de Geer could not understand the occurrence of thirty or forty feet of stratified sand between two moraines of the same glacier. The colors are sometimes the reverse of what has been stated by Dr. Holst, and the boulders in the two moraines have been derived from different sources.

Mr. Christie described the section of peat and silt between two layers of till occurring on the river Clyde, above Glasgow.

Mr. Cadell described some five distinct layers of till occurring in a pre-Glacial river channel in Eastern Scotland; and also mentioned another river channel, filled with coarse gravel derived from rocks occurring farther north in Scotland, which was covered with a later layer of boulder clay.

Mr. McGee mentioned the importance of land forms in interpreting geological processes. Any primary geological classification must be genetic. He discussed in detail the following scheme of classification of Plistocene deposits:

Classification of Plistocene Formations and Land Forms.

A. Aqueous:

1. Below base level.
    a. Marine.
    b. Estuarine.
    c. Lacustral.

2. At bass level.
    a. Littoral.
    b. Marsh.
    c. Alluvial (certain terraces, etc.)
3. Above base level.
    a. Torrential.
    b. Talus (including playas).

B. Glacial:

1. Direct. (Chamberlin's class I.)
2. Indirect. (Chamberlin's classes II. to V., in part.)

C. Aqueo-Glacial: (Chamberlin's classes II. to V., in part.)

D. Eolic: (Chamberlin's class (?) VI.)

1. Direct.
    a. Lava sheets.
    b. Cinder cones.
    c. Tuffs, lapilli sheets, etc.
2. Indirect.
    a. Ash beds.
    b. Lapilli sheets.

Prof. Chamberlin, in closing the discussion, said that there was great difficulty in applying a chronological classification, and that such a classification might even act as a barrier to observation and to the recognition of the truth. Chronological classification is the ultimate goal of glacial studies, but it is something for which we are not as yet prepared. Red, oxidized subsoils are not developed in northern latitudes. Organic deposits between glacial layers are abundant in the west, but do not belong to a single horizon. Many facts of erosion and physical geology indicate that the Glacial epoch in America was widely differentiated, and of long duration. How many distinct periods it embraced we do not as yet know.

Prof. Cope: An abundant tropical fauna is found in the "Equus beds," which, if they be of interglacial age, indicates at this time a warm climate. This fauna is succeeded by a truly boreal fauna. In this is contained material for a chronological subdivision of Pleistocene deposits.

Prof. Gaudry read the following remarks at the close of the congress:

Mr. President and Ladies and Gentlemen:

We regret that Prof. Joseph Prestwich, president of the fourth international geological congress, was not able to be present to install

the officers of the fifth congress, but we are pleased that he should have delegated in his place Prof. Hughes, who is so appreciated by all geologists. We regret also that Prof. Newberry is not in attendance to preside over our deliberations, as we had hoped. In the excellent work which he has recently published on the fossil fishes we were shown a sample of his vigor and his spirit, but unhappily his physical strength would not permit him to attend at our call, and preside over this congress. But to console us we have chosen another eminent geologist, Prof. Joseph LeConte. In the name of my brother geologists I have to thank him for the talent and kindness with which he has directed our session. It is now thirteen years since we organized at Paris the first international congress of geologists. My friends MM. Delaire and Barrois, who are here with us to-day, and who were secretaries of that first congress, can tell you that we were not then without inquietitude for its success. Thanks to the Lord and thanks to you, it has developed into a complete success. We ought not to forget that if it was at Paris that the first congress was organized, it was in America that the project was started. Hence sprang the generous and fecund idea to unite the different members of the great family of geologists. I am but the interpreter of the sentiments of my brother members of the international congress of geologists, whether present or absent, in addressing the most cordial thanks to the American savants who were the inspiration of this congress. The congresses at Bologna, Berlin, and London had grand success, while this at Washington is not less satisfying. In truth, we have not made any new regulations, and the anterior congresses made many. There are regulations for nearly everything *en peu faut, pas n'en faut.* We should guard against personality, and ought always to respect the liberty of science. It is most important that we should elevate science in the greatest degree possible. Our domain is immense, since we make the history of all the earth. We should give to our spirits an amplitude equal to that of the vast domain which we are charged to explore. By the natural force of things each one of us is drawn to study special branches; in order to make original work, one must concentrate his power upon a single branch of science. Some of us are pleased to make our researches among the vertebrates,—strange and gigantic animals which peopled our continents in past times. Others attach themselves to the study of invertebrates,—creatures humbler, but which render great service to geology in the determination of the ages of the earth. Still others consider the flora, and make corresponding classifications. Some prefer the primitive *terrains* which reveal to us the

origin of life, while still others prefer the secondary and Tertiary ***terrains***, which show the world in a more advanced state, and so continue the mystery of the origin of humanity. Many of our brethren occupy themselves with physical or chemical geology. We have reason to hope much from this division of labor. It is necessary that at certain periods we should collect all the products of our activity, that we should show to the world wherever interested, and to our brother geologists, the various processes by which we have arrived at our conclusions. Each one of us is but a minimum, but the entirety of our knowledge will form a marvelous structure, and one of great strength. Such is the work of our international congress.

Gentlemen, we have the good fortune to be co-workers, and as such we should love and be loved by one another. I believe I am the oldest of all the geologists who have crossed the Atlantic Ocean to attend this congress. I have met many ardent workers in my life, and I declare to you in all the sincerity of my soul that the more I see and the better I know the men of science the more and better I love them. It is a long time since we learned to admire the American geologists, but we come now to learn to love them. In returning to our homes in the Old World we will carry with us a cherished souvenir of the members of the international congress of geology at Washington.

The following names were recorded as the Founders' Committee: James Hall, T. Sterry Hunt, J. W. Dawson, J. S. Newberry, C. H. Hitchcock, R. Pumpelly, J. P. Lesley, T. H. Huxley, O. Torell, E. H. de Baumhauer.

The following members of the congress were present from foreign countries: *Austria-Hungary*—Dr. Karl Diener, a. d. k. k. Universität, Wien; Dr. Emil Tietze, Chefgeolog des K. K. geol. Reichsanstalts, Wien. *Belgium*—Prof. Max. Lohest, à l'Université, Liége; Dr. Xavier Stainier, Com. géol. de Belgique, Bruxelles; Mr. E. Van Broeck, Commission géoligique de Belgique, Bruxelles; *Canada*—Frank D. Adams, McGill College, Montreal; Thomas MacFarlane, Inland Revenue Dept., Ottawa. *France*—Prof. Dr. Charles Barrois, à l'Université, Lille; Mr. Marcellin Boule, du Muséum d'hist. nat., Paris; Prof. Albert Gaudry, du Muséum d'hist. nat., Paris; Mr. Emm. de Margerie, Service de la carte géol. de la France, Paris. *Germany*—Prof. Dr. Achilles Andreae, an der Universität, Heidelberg; Prof. Dr. E. W. Benecke, an der Universität, Strassburg; Dr. Alfred Bergeat, München; Dr. Georg von dem Borne, Halle; Prof. Dr. Her-

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An excursion to the Rocky Mountains under the guidance of the U. S. Geological Survey followed the adjournment of the congress. On reaching Salt Lake the party divided, one part visiting the Grand Canyon of the Colorado, the other the Yellowstone Park. A remarkable peculiarity of this excursion was the fact that it was made at the expense of the visitors, the hosts charging each of them $265.

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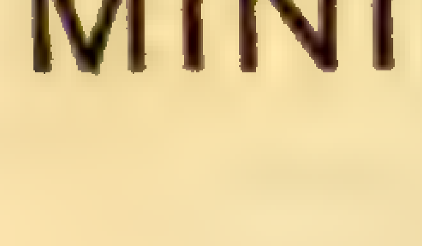

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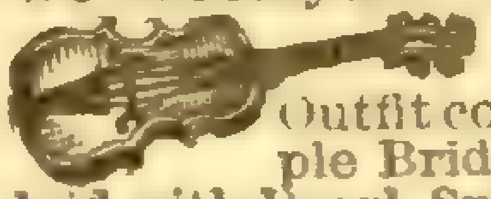

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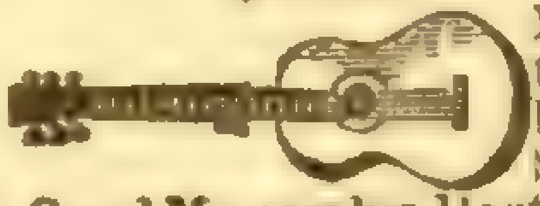

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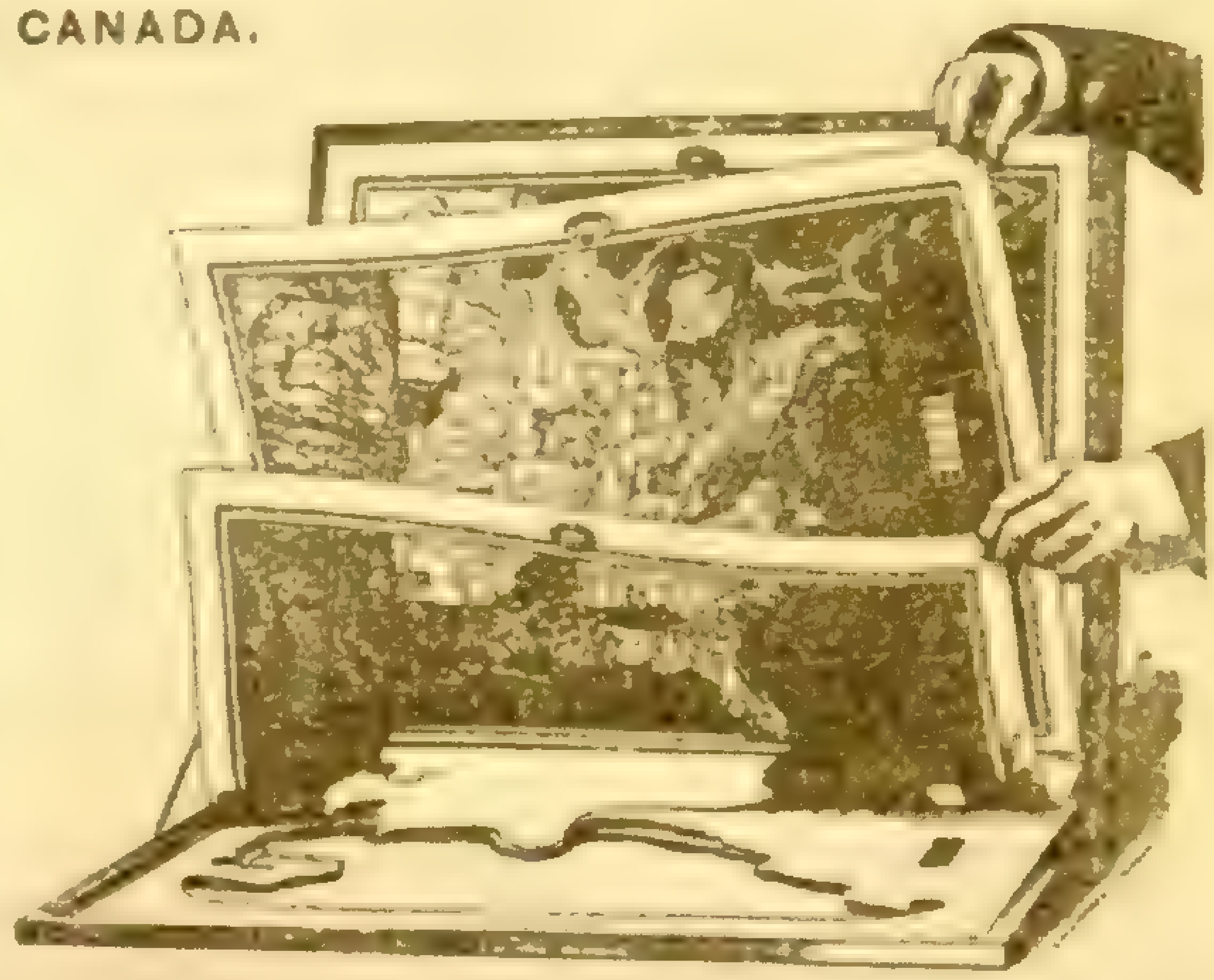

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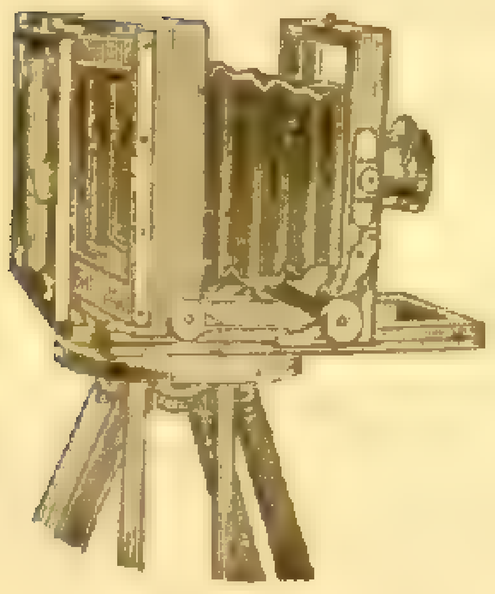

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THE

AMERICAN NATURALIST

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LANGUAGE AND MAX MÜLLER.

BY S. V. CLEVENGER, M.D.

THE talented linguist who has contributed the series on "Language and Thought" to the *Open Court* says: "Certain it is that no philosopher has as yet utilized the new facts which the science of language has placed at his disposal." As most of these new facts are but corollaries of the evolutionary theory, and as philology was revolutionized by that theory and put upon a sure foundation, the remark is incautiously made. Herbert Spencer pointed out paths for the philologist and anticipated much that has been proven; August Schleicher discusses in accordance with the theory of natural selection how the various forms of speech have developed and divided into dialects and species; and Wilhelm Bleek has dipped into the origin of language. Friedrich Müller's ethnography, which accords language the first place in racial determinations, supplanted the Blumenbachian division into five races, based upon the Semitic myth of descent from a single pair.

Language and speech are used interchangeably by Max Müller, though gesticulation is tacitly and finally directly included; and how proper this inclusion is the science of cerebral physiology fully shows, yet not a single allusion was made to this important field of research. Müller claims a place among the physical sciences for the science of language, though he seems to completely ignore brain anatomy, general physiology, ethnology, and other cognate sciences that interpret speech processes.

There should be no underrating of the great value of Max Müller's work. He has built himself an enduring monument in his contributions to philology; but I affirm that his labor has been more in the line of polyglot grammar generally. It is no slur upon the value or extent of Müller's work to say this, for this department of philology is just as capable of being deeply mined as any other portion of human knowledge; but Müller has missed availing himself of what had been worked out by other thinkers.

That he has become entangled in the mere wordiness of some ideas is apparent in his stating that Darwin has shown the inappropriateness of the word species, but that he has substituted varieties in its stead. Müller admits genera and individuals, but neither varieties nor species. Now if there was one thing above all others that Darwin did make clear, it was the trashiness of all these terms, from genus to variety, when used in the olden fixation sense. Nevertheless, in chemistry, botany, zoology, and even where the arbitrary relative terms genus, species, and variety are indispensable, nothing is capable of absolute classification; for everything is relative. Even the vertebrates cannot be sharply set apart from the invertebrates, for we are compelled to include the notochordal animals without backbones among the vertebrates. What Darwin did was to show that species, the limbs of a tree, were not trunks of separate trees, but that twigs and branches were often undistinguishable apart.

Throughout Max Müller's writings he is handicapped by his exaggeration of the importance of his particular line of research carried on as an isolated study. Could he but have a fair knowledge of associated sciences, such as that of anthropology, anatomy, physiology, and zoology, the value of his work would be greatly increased, and his inferences would undergo radical changes. He seems to base everything upon the derivation of a word, and says that etymology should not be laughed at. Undoubtedly a careful study of vocabularies aids us in tracing the origin of races, but languages have always been in an eternal flux, even though the meaning of words may sometimes show the intention with which words were framed, and in a few instances

give an insight to the thoughts of Paleozoic people. Those who have lived with savages, and are familiar with the puerility of their conceptions and their disposition to incessantly invent words and then forget them, are able to estimate gibberish at its proper value. When Chicago was a frontier trading post, log cabins and tents domiciled the people. Frame houses took the place of these as the village grew. Occasional small brick houses appeared as the town spread out; but scarcely a vestige of any of these dwellings remains among the towering masonry of the Chicago of to-day, with its million and a quarter of inhabitants. Too little attention has been paid to the fact that a growing, living language receives accessions from all sides. Our modern English is a fearful jargon, combined from many ancient and modern languages, civilized and savage; and necessarily so will speech be with a people who are living, expanding, in a restless age, accumulating ideas from all parts of the world. It is a very common mistake of the theologically biased, who imagine that language had a directly divine origin, that simplicity of construction of a tongue indicates this and is to be admired; when the fact of the matter is, irregularity of declension and conjugation are invariably produced by the mingling of people who speak different languages.

The Australian savage language is exceedingly regular and simple, in keeping with its poverty of ideas. The Spanish language is probably the most beautiful, resonant, inflexible, of any of Latin descent. But what is there in the Spanish language? The inquisition, in destroying thousands of thinkers in that country, male and female, helped to fix and impoverish Spanish brains and tongues. There is always wanting a proper consideration of the fact that, so far from being dependent upon language, far too often language has deranged thought, introduced confusion where even the deaf and dumb have thought more clearly. Gesticulation is an important means of communication between savages, so much so that the Australian primitive people could not understand each other in the dark; and the Chinese frequently resort to writing to make themselves better understood.

Müller wishes language to be regarded as a physical science. Granting that it is such, why then should it be isolated from all other sciences? Chemistry would be lame indeed without physics; and what would astronomy be without either?

Berkeley was right in saying that words are often impediments to thoughts. They do in many cases convey wrong impressions. They are false symbols, and, being inadequate, choke the intellectual processes.

Huxley says that the sooner you forget the derivation of a word, and use it in zoology, etc., as a mere arbitrary associated name (*nomen proprium*), the better you are off.

The fact cited, that the Greeks had but one name for language and thought, is about as important as that the Cheyenne Indians have but one word for head and leg.

The illustration of Gambetta shows that by habit thinking can be elicited in some only by speaking. It is an exercise of the symbolic field; but how is it that we find some of our greatest thinkers most reticent? Sir John Hunter could express himself with difficulty, and the most voluble elocutionist or orator may have an empty head.

Müller is unequivocal in making thought inseparable from language and considering them identical. "We think in names, and names only," he says. Do we? What did Caspar Hauser name his guardian?

Hobbes is quoted approvingly in saying that "truth and falsity have no place but among such living creatures as use speech," when the fox and wolf resort to subterfuges, and dogs and cats know that playing is not in earnest.

He reduces all languages to a few words, and then turns his back upon what it indicates,—that man came from primitive stock. He states that "nature produces the greatest effects by the smallest means," and yet Müller turns to the supernatural to account for language.

The "bow-wow theory" is contemptuously disposed of, and "*clamor concomitans*" is not anatomically referred to as depending upon effort and air expulsion from the throat.

He is like a blind would-be botanist who tries to picture trees by listening to the wind blowing through the branches.

Attempt a word analysis of a single expression,—appearance of eyebrows, wrinkles, corrugations, depression or elevation of nose and mouth,—and reflect what cumbersomeness words entail upon thought.

What words does the momentarily rapidly performed face reading require? You see expressions of myriad kinds flitting over faces,—you read them, but not in words. You cannot or do not analyze them. The unconscious association of the expression with an impression, true or false, which that expression makes upon your mind, it is impossible to put into words.

Mill is referred to as making logic depend upon words. Now imagine the logical deduction of a soldier who sees a gun pointed at him, and hence reads himself an essay that ends in advising himself to dodge behind a tree.

"Dumb animals" cannot be denied thought, they do not even analyze consciously their impressions, yet they study conditions to advantage, make up their minds to act offensively or defensively without a word; the infant does pretty much the same, so do the deaf and dumb.

Passing now to demonstrate facts, making a study of the machine instead of the noises it makes, it is well known to physicians that the seat of language in the brain in right-handed people is in the left side a little in front of and above the ear. In left-handed people the location is upon the corresponding right side of the brain.

These facts have been ascertained by exceedingly simple means, an injury to those portions causing an interference with the speech function, sometimes to the extent of destroying it. This speech function may be wholly and totally obliterated by disease, and yet the individual may be capable of transacting business, buying, selling, and directing his affairs generally and intelligently. He may make a will disposing of his property, he may think deeply and correctly, and yet be unable to express himself by speech; and on the other hand thought may be badly deranged and the speech faculty may remain intact. If language and

thought develop together and symmetrically, then the voluble Blind Tom should be a pundit instead of the idiot which he is. The ability to write may be taken away from us by disease and the faculty for speaking be left unimpaired; and per contra aphasia, or speech interference, may exist without agraphia, or the loss of the ability to write. These facts alone tend to disprove Max Müller's dicta. But much more can be added. In the disease called chorea or St. Vitus's dance, if the derangement of the motions begins on the left side the speech is not affected until the right side also of the body is diseased. Although in a very severe case of chorea in a young lady of twenty two the patient told me that her thoughts were perfectly clear until she attempted to speak, and then she became confused, this does not indicate that her thoughts and speech were inseparable, but that when she voluntarily attempted to translate her thoughts into speech the want of coördination produced mental confusion, and consequently speech inability. The maniac thinks too fast to be able to connect his words intelligently. It is a pernicious notion that ideas depend upon words; but "object teaching" alone disproves it. The senses may know things better than words can express them. We know that we can understand objects better by seeing, feeling, etc., rather than by description. Words indicate things; but we have to understand what those words mean first, showing that understanding precedes words. Language may in some increase the capacity for higher thought, but language cultivation alone does not increase thoughtfulness. The gymnast is not a watchmaker or pianist, nor is the elocutionist an originator. The talking ability of the parrot may be cultivated to its highest extent, but that bird will remain as thoughtless as any of his dumb ancestry.

When the right side of the body is paralyzed the speech ability is usually lost at the same time, and the mind may or may not be involved; but when the left side is paralyzed the speech is not impaired unless the patient is left handed, and the mind is less apt to be affected in left-sided paralysis.

An arm, a leg, one side of the face may be paralyzed, with or without speech disease, from brain injury, depending upon the

part of the brain affected. Certain areas of the brain preside over voluntary control of fingers, arms, legs, lips, lungs, etc., and movements of these to perform intelligent coördinate action are regulated by spots of brain surface called centers, which are nourished by special blood vessels. According to the extent of damage to these vessels will be the degree of paralysis, whether restricted or general, involving one or many bodily parts.

Slanting diagonally downward and forward in the outer part of the brain, just above the ear, lie these centers that control the arm, leg, fingers, and speech parts, and this portion has been appropriately termed the "symbolic field," because through its exercise and integrity man is able to gesticulate, point, threaten, with hands or feet, or to regulate the motions of the diaphragm, larynx, tongue, lips, in a comparable manner, to produce conventional sounds that serve better purposes than making gestures, but to the same end,—to make himself understood. It is difficult for us to consider the regulation of sounds into language as equivalent to gesticulation, but nevertheless nature makes but little distinction between her methods of symbolizing in these ways. The savage uses gestures where his speech centers are poorly educated, and the linguist represses his use of bodily contortions because his words can make him better understood. The ear has been trained to understand the minute variations in sound involved in speaking, where previously the eye interpreted less satisfactorily the symbolic movements.

And just as the symbolic field develops in man, so that part of the brain was built up and lifted the forehead into a more upright plane. But the fact that this symbolic field may be destroyed and thought remain shows that thought is not centered in that part, but is merely associated with it. To a great extent the mentality resides in the left frontal lobe, just in front of this symbolic field. This part may develop with or independently of the speech, leg, or arm centers, proving that thought is not language, but that language is merely a means of expressing thought, just as any other gesticulation is.

The baby's movements are at first badly regulated; he kicks, sprawls, and throws his arms, often in the wrong direction, when

he attempts to grasp some object. He merely denotes pleasure and pain in general by laughing and crying. Little by little the infant regulates his movements for walking and handling, and acquires the ability of pointing at or motioning away persons, denotes pleasure by nods and smiles, and displeasure by shaking his head or turning away, and soon he begins to articulate such words as "go way," "lemme alone," etc.

Nothing could be simpler and more convincing, by way of refutation of Müller's position, and innumerable facts of the kind could be additionally brought forward to demonstrate that thought is one thing and language another, and that he might as well say that thought is gesticulation of all kinds, for language is, after all, only gesture of vocal parts.

An important inference from this is that manual training would develop the symbolic field of the brain and afford a basis for mental development, where purely linguistic studies would tend to create inefficiency by crowding the speech center with symbols that are seldom used, comparable to the differences in education and usefulness that exist between the skilled mechanical engineer and the clownish contortionist.

THE PERMIAN, TRIASSIC, AND JURASSIC FORMATIONS IN THE EAST-INDIAN ARCHIPELAGO (TIMOR AND ROTTI).[1]

BY AUGUST ROTHPLETZ.

TWO years ago my friend Wichmann, professor in the University of Utrecht, in Holland, sent me a rich collection of Mesozoic and Paleozoic fossils, which he had made during his geological exploration of the Dutch colonies in India, in 1888-'89. All these fossils came from the west side of the island of Timor and the little neighbor island of Rotti.

Timor is a locality well known for Carboniferous fossils, which were described in 1865 by Professor Beyrich, in Berlin. He knew then eighty species from a little river near Kupang, and from another place one Ammonite, which he considered as a representative of the Mesozoic fauna. But Professor Wichmann found nearly the same Ammonites in the Paleozoic strata of that little river near Kupang. Therefore we must regard all these Ammonites as of Paleozoic age.

Though Triassic strata are not yet known at Timor, they have been found on Rotti by Wichmann, with the shells of European species of Monotis and Halobia; and in the mud of a volcano have been included, together with some Paleozoic fossils, like those of Timor, a few truly Jurassic remains,—also in part of European character. From the Paleozoic strata I know at present forty-three species, of which twenty-five are not yet known from any other country. The other eighteen only give us the opportunity to make out the exact age of these deposits. I shall mention them especially:

Six species are spread out over many parts of the earth and during many epochs of the Carboniferous and Permian periods: *Spirigera royssi, Spirifer lineatus, Spiriferina cristata, Productus semireticulatus, Fenestella virgosa*, and perhaps *Amplexus coralloides*. Three species are found in the Upper Carboniferous and Per-

[1] Read before the American Geological Society, August 24th, 1891.

mian strata of India, and in part of Russia: *Terebratula himalayensis*, *Retzia grandicosta*, and *Spirifer musateheylensis.* Nine species at least belong only to the Permian period, and seven of them have been found in the Salt range of India, three in Armenia, and one in Russia.

So we have in Timor no species which could be considered as of exclusively Carboniferous age (except perhaps *Amplexus coralloides*), but nine species of exclusively Permian age; and therefore we cannot doubt that the fossiliferous Paleozoic strata of Timor belong really to the Permain period.

In favor of this opinion may also be mentioned the presence of Ammonites, which are not yet known as having existed in the Carboniferous period. The *Ammonites megaphyllus*, which was described by Beyrich, and placed, together with the Triassic *Ammonites farbas*, in a particular group, has since played a remarkable part in the story of systematic arrangement.

First it was raised by Mojsisovics to the rank of a head of the genus Megaphyllites, in 1878. But after a few years the head got disgusted with his family, and fell in love with a young American lady, called by Hyatt *Propanoceras* (1886), in whose bonds he remained but a very short time, for he had become a very fickle fellow, and was running after some other Russian and Italian ladies, as Waagenia, Waagenina, and Stacheoceras. But these seem to have been only transitory passions, and, becoming older and calmer, he found at last the harbor of the genus Arcestes, where I hope he will pass his days peacefully, together with his new compatriot, the *Arcestes tridens.*

Now we have to consider another very interesting fact: that none of the exclusively Permian species of Timor occur in Australia or America. This seems to prove that Timor was a part of that Permian sea that covered the northern part of East India, Armenia, and Russia, and which was limited at the south, and perhaps at the east too, by that old Australian-Indian and African continent on which, in the same time, the wonderful Glossopteris flora was growing.

So also no near relations exist with the middle and northern parts of Europe. The European flora and marine fauna of the

Permian period is more distinguished from the Carboniferous flora and fauna by the dying out of older species and genera than by the growing up of new types. It looks as if Europe, with her shallow seas and her isolated and often inundated land masses, had been at that time the refuge for the Carboniferous world, which was retiring from the battle with younger and stronger people that came in from the east and south.

Therefore, if we would become acquainted with the true Permian flora and fauna, we must not address ourselves to Europe, but to the eastern and southern continents. There we find the marine fauna in a free and rich developement like that which we are accustomed to see in the Lower Carboniferous period in Europe; and this gives to the eastern Permian fauna an appearance by which it looks more related to the older Carboniferous than to the contemporaneous Permian fauna of Europe. Some geologists have been really disappointed by that appearance, and take the true Permian fauna as the development of a separate period that existed between the Carboniferous and the Permian periods, and which they have called the Permo-Carboniferous period.

But in this they are quite wrong. The aggregation of Carboniferous and Permian species in the fauna at the beginning of the Permian period is nothing extraordinary or nothing that should not be expected. We know the same as existing on the boundaries of the Triassic and Liassic, of the Jurassic and Cretaceous, of the Cretaceous and Tertiary periods. The fact is sufficiently marked by the names of Rhætic and Infraliassic, of Tithonic and Berrias, and of Laramie.

The Triassic formation is represented on the island of Rotti by white, gray, and red limestone plates, sometimes full of bivalves, Except one new species, *Halobia wichmannii*, I could state the presence of six European species: *Monotis salinaria*, *Halobia lommeli*, *lineata*, *charlyana* (syn. of *mediterranea* Gemallaro), *norica* and *Daonella cassiana*. All are representatives of the upper Alpine Trias, three have also been found in Sicily and two in the Himalaya. Therefore we must suppose that, as in the Permian period, so also in the Triassic time, a large sea-basin existed that covered and united Europe and East India.

But as the Permian fauna did not show a close relation to the eastern fauna, so also there are no relations between the East Indian Triassic fauna and that of New Caledonia, New Zealand, and Japan, where the Monotis seems to be represented by the genus Pseudomonotis.

That this remarkable connection of the East-Indian archipelago with Europe by the intervention of the Himalaya still continued during the Jurassic period is proved by the discovery of Liassic and Oölitic fossils on the island of Rotti,—as, for example, *Arietites geometricus*, *Harpoceras* cf. *Eserii*, and *Belemnites gerardii*.

It is probable that only after the Jurassic period the East-Indian archipelago came out of direct connection with the European sea, and remained so until now.

THE HAT CREEK BAD LANDS.

BY J. S. KINGSLEY.

A WEEK to spare in the last part of May, railroad transportation available, and the Bad Lands of Nebraska accessible, —who could refuse the trip? The four who made up our party certainly could not. So we started, taking the train for Harrison, Sioux county, aiming to visit the little Bad Lands of the Hat Creek valley, for these were more easily reached than the larger Bad Lands of the White River, and besides they were not as well known or so much explored.

A week's trip is not much to write about, but in a week one can see a good deal, and then in a week the novelty of the strange scenes has not worn off, and the features of the wonderful landscape can be better described. No inhabitant of the West Indies could describe these striking features in such a striking manner as has the late Canon Kingsley. The Bad Lands are often mentioned, but as yet the descriptions of the regions are not numerous.

The journey from Lincoln was without event. First came the climbing out of the valley of Salt Creek, then the long, straight line of track for thirty-five miles, and next the descent into the valley of the Platte at Grand Island. The Platte is a strange stream. Geologically speaking, it is a new river, which has not yet been able to master its sediment. It is broad and shallow, and a deep hole is excavated only to be immediately filled by the shifting sands of the bottom. In dry seasons there are long stretches where no water is visible, but down in the sand the water is still running to the Missouri.

Across the Platte the railroad strikes for the Loup valley, crosses the South Loup, and follows up the fertile fields of Mud Creek. A little beyond Broken Bow the "sand hills" are reached, and through them for two hundred miles we ride. There is nothing picturesque in the landscape now. One can easily imagine himself among the sand dunes of Cape Cod or the New

Jersey shore. Yet these hillocks of shifting sand and scattered tufts of coarse grass are interesting, for in them we find evidence that this portion of Nebraska was not so treeless as it was when the first settlers entered it. As the sand blows it uncovers here and there the well-preserved trunks of pine trees. What could have caused their extinction? Certainly not change of climate, for in the cañons in this same region the same pine grows abundantly.

Beyond Alliance we cross the upper Niobrara, and the landscape again changes, for we have now to cross that long line of hill, Pine Ridge, which extends for over a hundred miles across the northwestern corner of the state. On the southern side there is nothing striking except the pine trees. These have a different habitus from pines in the east. In Maine and in Michigan the pines form dense forests; but here they are scattered like the spruces on a lawn. The train now goes through a tunnel, and we enter the valley of the White River. What a change in the landscape! It is no longer tame, but it is cut and eroded into the most fantastic shapes. To the north is the valley of the river,—here a small stream,—and from it the grassy slopes ascend gradually for several miles; then a more rapid rise, and then the Buttes. Look where you will, you see them. You are among them while far to the north. Clear across the White River you see the same formations. One cannot help thinking that here the process of world-making was suddenly interrupted.

From Crawford to Harrison we follow up the White River. We climb first to the foot of the Buttes; then above them to a broad, level prairie, much like those in the eastern part of the state. Here we find the town of Harrison, 5,000 feet above the sea, where we leave the cars and take a wagon for the Bad Lands.

For three miles north the road gradually ascends, and we strike the head of one of the cañons which are to lead us to the Hat Creek valley. Did I say we were above the Buttes? Even in this highest point we see here and there slight piles of rock, the last remnants of Buttes which once covered this region.

Down the cañon we go, three or four miles, thirteen hundred feet fall. Again we enter the line of Buttes. Those we saw before were the buttresses on the White River side of this divide; those we now see are those of the Hat Creek valley. Follow the horizon around, and everywhere there are the same fantastic forms, extending thirty or forty miles to the north. Away beyond them rise the dark outlines of the Black Hills, and towering above all is Harney's Peak, a hundred and twenty miles away. Halfway down the cañon we followed, came in a side cañon, and here were the most wonderful Buttes of all. In their outlines they reminded us of ruined castles, fortifications, and the like, on a gigantic scale. The lines of stratification of the creamy-white limestone resembled the courses of masonry, while the crevices cut the outline into buttresses, terraces, and embrasures. At the end of the cañon nearest us the resemblance was most striking. The corners were square cut, and the perpendicular walls were between a hundred and fifty and two hundred feet in height. Above them, in the center, towered another mass of rock, fifty feet or more,—just as did the keep in many a mediæval castle.

The broad valley of Hat Creek slopes gradually down from the Buttes, and as we first saw it it looked as if carpeted with grass. A closer glance at the vegetation showed us that here the buffalo grass was not extinct, while the cactuses and sage-bush showed that the land was none of the best. A most striking feature was the number and brightness of the flowers. A little white lily was everywhere, while the bright-colored "loco weeds" (Astragalus and Oxytropis) gave a variety. Throughout all the west these weeds are said to render the animals which feed upon them crazy or "locoed." There is a chance for some investigation here. One of the most striking of the flowers was a little Frittillaria, never before known to occur as far east as Nebraska. It is a graceful lily, with its petals nicely marked with yellow and a purplish brown. At Lincoln fully half the flowers were old acquaintances which I knew in the Atlantic states; but here, four hundred miles from Lincoln, every plant was a novelty. It was interesting to note how closely every plant hugged the earth, the sage-bush and the Spanish bayonet excepted.

As yet no Bad Lands. At last, as we rode along, one of the party, who had been there before, told us not to look up until he spoke. Three minutes passed, and then the signal came. We gazed on the most desolate spot I ever saw. For miles it was all the same. The names Bad Lands and its French equivalent, Mauvaises Terres, need no defense. Not a bit of green,—nothing but that creamy-white, calcareous, clayey rock; and this was not level and flat, but eroded into the most irregular surface one could imagine. Ridge and gully, ridge and gully succeeding each other for miles,—the summits of the ridge as sharp as the roof of a house, while the gullies in most instances were not wide enough to allow the passage of anything larger than a wheelbarrow. It was a magnificent chance to study erosion; but how was it eroded? The gullies were as dry as the crests of the ridges. Here and there we struck broader gullies, but even here soil was lacking and nothing green was to be seen. The light reflected from the creamy ground was very trying to the eyes, while the heat on a warm day was oppressive. Not a breeze finds its way into these narrow valleys. The walls sometimes rise at the angle of forty-five degrees; at others they are all but perpendicular. They vary from fifty to one hundred and fifty feet in height. The strata of which they are composed are not homogeneous. For the most part they can be easily cut with a knife; but here and there there are harder bands, and this alternation gives rise to strange erosion figures. The lower and softer strata wear away more rapidly than the upper and harder beds, and at one place the result was startlingly like a sitting man with a slouch hat. In places one finds vertical fissures filled with—now gypsum, now calcite.

These Bad Lands are most celebrated for the fossils they contain. In the higher levels of the Buttes fossils are scarce. I am told that they yield but few turtles, and nothing else. In these lower strata of the Bad Lands mammalian remains are abundant, as well as turtles. Some of these latter are small, scarcely three inches in length; some are veritable giants, the carapaces measuring nearly three feet by four. Turtle remains are very abundant. Some are as perfect as when the animal died, while others have

PLATE XX.

BAD LANDS OF HAT CREEK.

succumbed to the frosts and present the collector naught but disarticulated plates. The scarcity of turtle skulls is noticeable; our party collected only a lower jaw, while we found two turtle eggs, one in perfect condition. In one place the turtles presented an interesting phenomenon. They had resisted erosion better than the underlying stone, and as a result in a small area there were about a dozen turtles, each supported on a slender post about two feet above the surrounding surface, while there were as many more which had tumbled down and left the standard to disintegrate.

We had not sufficient time to carefully hunt for fossils and to take only the best, so we did but little digging. It is a tedious process to get a fossil out from its bed. The necessary apparatus consists of a picking hammer, a quantity of tough manilla paper, paste, and patience. When a fossil is found imbedded in the rock, the exposed portions are covered with paper pasted on, and then the paste is allowed to dry. Now more is uncovered with the pick; paper is pasted on again, and so on until the whole is separated from the rock. Excavated in this way the bones are kept in just the relations in which they were found, while the paper protects them from injury in transit. Instead we followed along the gullies searching for the fossils which had been weathered out, and when a portion was found we followed up the wall above it hunting for the rest of the animal. The result of this method of collecting was that we got quantities of fragments; but we also found considerable that was more complete, some of it valuable.

Most abundant of all the mammalian remains were the *Oreodons gracilis* and *major*. These were small animals about the size of a good-sized dog, unlike anything which now exists. Their line is extinct. In some of their features they resembled the pigs, and in others they were more like the ruminants.

Prof. Cope has recently shown their position in the conspectus of the vertebrates which he has published in this journal. He also published a synopsis of the Oreodontidæ in the Proceedings of the American Philosophical Society for 1884, while Prof. Scott, of Princeton, has a valuable and beautifully illustrated paper on them in the *Morphologisches Jahrbuch*, of later date. Other forms which occur more or less abundantly in these beds hardly agree with the fauna of Nebraska to-day. There are

bones which recall the camels and the alpacas ; forms which are intermediate between the rats and the squirrels, and others which may be the granddaddies of the horse. Then there were still others which fed on these grass-eating species: tigers with enormous canine teeth, and the still larger Hyænodons with teeth which close together like shears. It was a wonderful fauna which inhabited Nebraska and Dakota in the ages long past.

Will the Bad Lands ever be exhausted of fossils? The treasures of this region and of the larger bad lands of Dakota adorn the museums of the east, and every year collectors are at work. Of course the specimens which are weathered out can soon be picked up, but there are quantities left. In fact, the beds may be said to be inexhaustible. Each spring a new crop may be expected. What has been the history of the region? How did all these animals accumulate here? What makes the land bad? Why is it not like disintegrating rock elsewhere? These are some of the questions. There are few problems in geology which give their answer in a plainer manner. It is a veritable classic and pony.

These regularly stratified beds, layer after layer of marly material, twelve or fifteen hundred feet in thickness, must have been deposited on the bottom of an inland sea, while the character of the fossils—for mollusks occur here and there—shows that the water must have been fresh. To-day these strata are nearly as level as when they were first laid down. The eye cannot detect any departure from the horizontal ; and in the Buttes to the north can be traced layer for layer the same beds which occur in the Buttes to the south. There is, however, a slight dip in the strata caused by the upthrust of that strange mountain region, the Black Hills, to the north.

This lake drained the region around, but the geological history of all that region known as the plains shows that then, as now, the streams largely ran from west to east. Hence the principal affluents of this Miocene lake must have come from the west. The climate then was probably different from that to-day, for nowhere within two hundred miles is there rainfall sufficient to maintain such a lake as this.

On the shores of this lake and on the banks of the tributary streams lived those animals which supplied the fossils of to-day.

First and most abundant were the Oreodons and their allies. The number of their remains shows that they most probably formed large herds. Rarer were the horse-like forms, which, however, resembled but little the horses of to-day. Then there were camels and rhinoceroses, and largest of all the immense Menodus, the lower jaw of which measured about two feet in length. These animals fed on the vegetation, while the cats and Hyænodons of the time preyed on these. How the bodies were transferred to the place where we find the bones is a problem easily solved. Probably there were freshets caused by abundant rains, and numbers of animals were swept by the stream into the lake. Here the bodies floated about, disturbed by the gases of decomposition, until a part dropped here and another there. This explains the scattered condition of the bones to-day. Even in the solid rock it is unusual to find more than two or three bones together. Certain it is that these animals were not mixed where we find them.

At length the conditions changed. The lake still remained, gathering sediment at the bottom, but the mammalian remains are much scarcer than before, and even in the upper portions of these bad-land strata they are much less abundant than in the lower beds. What was the cause? I do not know. Still the lake continued laying down stratum after stratum until there was at least more than a thousand feet of rock piled upon the top of the fossils. How much more there was we do not know. The Buttes are our sole register in this respect. We no not know how much erosion there has been from their tops.

At last the lake became dry, and its old bottom was exposed to the air, and now erosion began. Looking across the Bad Lands from the tops of the Buttes, and seeing that valley forty or fifty miles across, and with an average depth of eight hundred or a thousand feet, one no longer wonders at the muddy Missouri or at the immense alluvial deposits which the Mississippi has made; and yet this same erosion is going on and has been going on at a thousand other places of equal extent.

Rapid erosiòn now ceased, and the broad valley with its gently undulating surface gained a soil. Then a second erosion began, and it is this second erosion which has produced the Bad Lands.

Here and there in this area we find a bit of what might be termed tableland or a small scale. The upper surface is covered with a scanty vegetation of buffalo grass, cacti, sage-brush, and *Agave angustifolia*, with the ever-present loco weeds. But the slopes of the tableland are abrupt, and not a bit of green can be found on them. The geological history of the region can be predicted. This erosion will go on until the ridges are all worn away, and the bad lands again become reduced to a plain. Then as Hat Creek wears a deeper channel, erosion will again be increased, and the Bad Lands will be repeated.

At first sight we all thought that the erosion was extremely rapid. The rock looks at first sight as if it would melt like sugar when it rained, but apparently this is not the case. My conclusions are that the winter frosts are the really efficient agents in the process. Rain and melting snow penetrate for an inch or two into the rock, and then the expansion of the freezing water disintegrates the outer surface of the rock, and it is only this outer portion which is soft. We found a place where for two years an irrigating ditch had emptied itself into the Bad Lands. It had nearly washed away this outer softened layer. The solid rock showed no signs of wear.

In studying erosion in this region one must remember that here the rainfall is not excessive. Some ten or fifteen years ago Prof. Samuel Aughey published some charts and tables, the object of which was to show that the rainfall was increasing rapidly in Nebraska. The lines on his maps were as firmly drawn as the contour lines in a topographical survey. But alas! there is no evidence, nor has there ever been, to support these charts and these conclusions drawn from them. The annual rainfall is given or regions and times when there were no observations and no one there to observe. To-day our statistics are scanty, and now reach back far enough to enable us to say whether the annual rainfall is increasing at all. Apparently from the slight data we have in the Bad Land region a rainfall of sixteen inches in a year is unusual. With that slight amount extensive erosion is not probable.

The question is asked, Will these Bad Lands ever be of value? Not in the immediate future. A country so extremely irregular is not available for agriculture. A few years ago this whole

region was occupied by cattle rangers, and thousands of heads were to be found here. Here and there, flowing down from the cañons, are small streams which afforded water, while in the dry climate the grass cures on the ground and is available for pasturage the whole year round. Rarely are the snows sufficiently deep to prevent the animals feeding in the open field. A few years ago the region was preëmpted by settlers. The cattle were driven out, and to-day the barb-wire fence shows the limits of the farms. But these farmers have a sorry time of it. No rain, no crops. I should not be surprised to see the whole country go back to grazing.

Owing to various circumstances we had but twelve hours' actual collecting time; and we went over but a corner, some six miles across, of the Bad Lands. Not much could be expected in so short a time and in such hurried and superficial collecting, yet when we got back to the railroad and packed our fossils we found that all four had obtained over 450 pounds. A list of the species we obtained would prove dry, but a rapid examination of the fossils showed some thirty or forty species represented by fragments or more complete remains.

Of animals we found comparatively few traces. The region is not such as to support an extensive fauna. We were told that mountain lions, timber wolves, and coyotes were comparatively common. In the Bad Lands and in the country surrounding we found several skulls and a good many horns of the buffalo. Horned toads are comparatively common in the whole region. The cacti form a habitation for a true cochineal insect; but to me the most surprising find was a scorpion in the Bad Lands. I did not suppose that they occurred nearer than Southern Kansas and Colorado, three or four hundred miles nearer the equator.

One of our party was an entomologist, and he obtained numerous good things on the trip. One evening, as we were making up our beds in the open air, we were completely covered by a small June bug. The entomologist told us that the species was described but a few years before from specimens which he collected. Scarcely half a dozen specimens represented the species in all the collections of the world. He took hundreds of specimens away with him.

ON THE QUANTITY AND DYNAMICS OF ANIMAL TISSUES.

BY J. LAWTON WILLIAMS.

EVERY ONE knows that the animal tissues are not fixed and unvarying quantities. From the time of an animal's first appearance in the outer world to that of its disappearance by the natural processes of dissolution it exhibits many morphological changes, so obtrusive as not to require comment. They are spoken of as developmental changes, and are often so radical and thoroughgoing that the later forms in the series bear no resemblance to their antecedent forms. Such are the total metamorphoses of certain insects, crustaceans, worms, and sponges. Partial metamorphoses are gone through even by the highest types, so that the adult form often possesses morphological characteristics which are not present in the young, or *vice versa*. But there are other less obvious changes which affect the tissues, and are not so easily studied by direct observation. Such are the changes in quantity arising from varying rates of nutrition and other disturbing causes. Besides these fluctuations, which are directly referable to immediate causes, there are others which appear to be constitutional, and proceed along definite paths of development throughout the lifetime of the animal. Moreover, these less apparent changes seem to adhere to animal species with much the same persistency that the more ostensible outward differences do. That is to say, just as one can distinguish an adult deer from its young by change in the form of its antlers, so, if he were a thorough expert, he could detect equally important changes in its internal parts which might serve as the basis of distinctions just as important as the ones here employed. In the absence of any extended investigations, it is impossible to speak with quantitative exactness of the inner changes from the time of birth to the attainment of old age. Such a record upon any one animal would be impossible from the very fact that the first investigation would deprive the animal of life. To conduct intelligent experiments

on different representatives of the same species would require a knowledge of the age, food, and environments of the different animals dissected, and then we would have to proceed upon a supposition, probably never realized in nature, that all the subjects of the experiment varied together in the quantity and distribution of all their tissues. Obviously such a supposition would be purely artificial ; and to insure all the conditions for the faithful execution of the experiment would require precautions so labored and extraordinary as to baffle the most skillful experimenter.

But while it is impossible to obtain exact and absolutely reliable data which may serve as the basis of laws of specific development, yet there are certain general and approximate methods which may lead to very much the same end. Such data may be derived in part by observations of the outward contour as determined by the plumpness or leanness of the animal. It is true that inferences based upon such observations may often be misleading, owing to our ignorance as to just what tissues produce the fullness or shrinkage in any given instance, and as to whether the same amount of shrinkage at different times is caused by the degeneration of the same or different tissues. Many valuable suggestions may be gleaned, however, from post-mortem examinations of typical cases. Such examinations, if found to be often confirmatory of previous conjectures, will tend to inspire confidence in our methods and results. There can be nothing more certain than that most mammals are subject to easily observable changes in their external contour from the time of their birth onward. Puppies and kittens, for example, are clumsy and thick-set when born, the latter being positively corpulent. As growth proceeds, however, the legs and body elongate, and the relative proportions of limbs and body are altered in a marked manner, the body becoming often quite lank. Quite the reverse happens to the calf and colt. They are very gaunt and long-legged, to begin with ; but grown cows and horses become decidedly thick and sometimes unwieldy. The muscles also change in form and relative dimensions. Changes like these are points of common remark in the human subject. Plump babyhood and childhood, spare youth, stout manhood, and weazen old age have all found place in familiar

proverb and song. All these outward changes are certainly expressions of inner changes equally important and significant.

In early life the vegetative functions preponderate. Eating and attendant growth are the all-important activities. But bye and bye the animal functions of motion come into play. Nutrition then ceases to be the dominant function, and the surfeited tissues give up their useless store to the growing demands of higher activities. The result is a redistribution to suit the specific needs of the animal organization in question. This redistribution does not cease until a new equilibrium is established which harmonizes with the existing orders of activity. Then a stage of equilibrium ensues, which may be called the balance of middle life. It continues until the already abridged functions of nutrition begin to yield further ground, weakened by the approaching exhaustion of an ebbing and dwindling vitality. This waning of the nutritive functions is manifested by a loss of flesh, and the angular, bony framework projects out through the wasted habiliments of muscular and adipose tissue. At last the vital store is exhausted, the nutritive processes cease, and the animal dies. Such, in brief, is the story of the average mammal's life, though the details are often disguised in various ways. While we cannot exactly formulate the variations of tissue at different periods, yet an average of many weighings will not lead us much astray. Such averages of different species closely allied may be compared with profit.

We are all more or less familiar with certain differences of absolute and relative weight and volume in the homologous tissues of different species. Results of this sort, especially on the brains of animals, are quite frequently met with. In all such cases, however, we are often perplexed to know, especially in animals with only remote systematic affinities, just how far it is legitimate to compare apparently homologous organs, and where such comparisons should end. For this reason it is generally well to restrict our comparison to animals of the same subkingdom, and, better still, of the same class, for the greater the divergence of remotely analogous tissues the less reliance can be placed on the comparative results. There are other difficulties which arise in the study of the quantities of tissue in the same animal. In

highly organized animals the differentiation of parts is often carried to such extremes, and the histological and anatomical lines of division are so ill defined, that we cannot say precisely where one tissue begins and another ends, and even the distinctions of a tissue as the material endowed with specific physiological functions is necessarily arbitrary and includes heterogeneous elements. To illustrate, it is not uncommon to find tables of the comparative weight of vertebrate brains. The value of such tables from the standpoint of strict homology is not very great. How utterly impossible it would be to find strictly homologous parts in all the cerebral tissues even in the different members of the class Mammalia! Certainly the range of physiological and psychological functions which these tissues discharge in the different members of the class is a very wide one. Some of them are unique and peculiar to one order, and are not represented in the others. Considerations like these bring us to realize that all quantitative studies of the tissues must necessarily proceed upon arbitrary assumption as to what parts are proper subjects of comparison. Probably, after all, the best method of pursuing such studies is to compare tissues with approximately the same physiological functions. This method I have pursued in the case of a few of the higher animals. The weight of the skins, skeleton, muscles, bones, and viscera were made the subjects of comparison. Under the last division were included not only the viscera proper, but also the lungs, brain, and all parts not properly falling under the other divisions. Under the head of skeletal muscles, tendons and ligaments were necessarily included; and under the head of the bones, cartilages and fatty marrows were included. Only a few dissections were made, and hence all inferences based upon them are necessarily incomplete, and require to be stated with extreme caution. The following comparative table gives the results:

Animals.	Skins.	Bodies.	Ratios of Skin to Body (approximate).
Woodchuck,	12 oz.	80 oz.	1 : 7
Rabbit,	3 oz.	23 oz.	1 : 8
Gray squirrel	5 oz.	25 oz.	1 : 5
Black squirrel,	4 oz.	24 oz.	1 : 6
Skunk,	13 oz.	3 lbs. 10 oz.	1 : 4½

Animals.	Muscles.	Bodies.	Ratios of Muscles to Body (approximate).
Woodchuck,	1 lb. 4 oz.	5 lbs.	1 : 4
Rabbit,	10 oz.	23 oz.	1 : 2
Gray squirrel,	12 oz.	25 oz.	1 : 2
Black squirrel,	11 oz.	24 oz.	1 : 2
Skunk,	13 oz.	3 lbs. 10 oz.	1 : 4½

Animals.	Bones.	Bodies.	Ratios of Bones to Body (approximate).
Woodchuck,	1 lb.	5 lbs.	1 : 5
Rabbit,	5 oz.	23 oz.	1 : 4½
Gray squirrel,	4 oz.	25 oz.	1 : 6
Black squirrel,	4 oz.	24 oz.	1 : 6
Skunk,	11 oz.	3 lbs. 10 oz.	1 : 5

Animals.	Viscera.	Bodies.	Ratios of Viscera to Body (approximate).
Woodchuck,	1 lb. 12 oz.	5 lbs.	1 : 3
Rabbit,	5 oz.	23 oz.	1 : 4½
Gray squirrel,	4 oz.	25 oz.	1 : 6
Black squirrel,	5 oz.	24 oz.	1 : 5
Skunk,	14 oz.	3 lbs. 10 oz.	1 : 4

The fact which impresses us most about these figures is that the relative proportions of the tissues here considered are far from constant in the same and in different animals. The right-hand figures in the column of ratios are well calculated to emphasize this fact. The tegumentary, bony, nutrient, and motor tissues do not each have equal weights in the same animal, and the ratio of their weights to the body-weights are not the same in different animals. For example, the ratio of the weights of the skin to the body vary all the way from 1 : 8 in the rabbit to 1 : 4½ in the skunk; the ratios of the muscles from 1 : 2 in the rabbit and squirrels to 1 : 4½ in the skunk; the ratios of bones from 1 : 4½ in the rabbit to 1 : 6 in the squirrels; and the ratios of the viscera from 1 : 3 in the woodchuck to 1 : 6 in the gray squirrel. Thus it appears that variations of one-half are not uncommon for the same tissue in different animals, and much profounder differences exist in the weights of different tissues of the same animal. Without doubt, more extensive dissections would reveal even greater extremes in the quantities of tissue in other mammals and in vertebrates generally. Certainly the nerves and the brain exhibit

immense quantitative differences in animals of different species. While the brain of the elephant, the largest of terrestrial mammals, has the greatest absolute weight, and that of the whale, the largest of all mammals, the next in size, yet among the smaller animals it is well known that the brain of man is preëminent in size. The brains of fishes and reptiles are exceedingly small in proportion to the size of the body, and the brain of Coryphodon, the prototype of the Ungulata, from the early Tertiary, was relatively much less than the average existing mammalian brain. The several tissues differ immensely in the range of their quantitative variations. Some of them, as the bones and muscles, grow under mutual limitations prescribed by the mechanical conditions of animal movement. If the animal is to move it must have motor tissues, and it must have hard parts upon which the motor tissues can act. The existence of the one necessitates the existence of the other, and that in certain quantity as well. The quantity of the one is reactionary upon the quantity of the other. If one is destroyed the other no longer has any use, and eventually suffers degeneration. Like relations subsist between certain correlated organs of the viscera. They act and react upon one another, and hence their growth and decline must go on together. There are other tissues the growth of which is mutually antagonistic. Darwin and Cope have cited the examples of the Artiodactyla where the evolution of the antlers is accompanied by a disappearance of some of the teeth. Facts of like import are not wanting in the case of the other tissues. Cope explains them by assuming that the animal has a fixed complement of vitality or bathmic force, and hence, by the principle of the conservation of energy, an expenditure in one form of growth must be compensated for by an equivalent suppression of some other form of growth. Cephalization is really a special case of this general principle, where the lines of maximum growth converge in a common direction. The acceleration of parts headward is coincident with the abortion of parts tailward. Under this view it is easy to suppose that the disappearance of the tail in man was accomplished by an enlargement of his cranial capacity, and the vital energy that was expended in its movement has now been trans-

formed into some higher psychical energy. Finally, there are some other tissues the quantity of which does not seem to be subject to the limitative adjustments of other tissues, because they are not directly concerned in the vital economy, and they fluctuate very perceptibly with the changing conditions of the animal's environment. Such is the adipose tissue. Cells of fat may increase independently of any mechanical laws prescribed by other tissues (of course within limits compatible with life), as in the omentum of corpulent people and the layers of adipose tissue in swine. We thus see that there are quite well-defined types of growth among the tissues of animals. There are those which increase and decrease together, those which increase at the expense of others, and those which vary independently. Of course these lines are not absolutely distinct, and probably every tissue in some degree embodies them all. This classification is given as having a general value only; but while there are specific and individual variations which have no apparent connection with any general evolutionary principles, there are variations, extending over longer periods of time, which have a historical value to the anatomist and paleontologist. They are the larger cycles of change in which these individual cycles move and exist. In the brief period of a human lifetime they are disguised by the seemingly irrelevant fluctations of the present, and it is only in the light of a remoter history that we gain a full conspectus of the progress of these events.

All through the Paleozoic and Mesozoic ages there was a remarkable profusion of molluscan and radiate life. Lime-secreting animals were the prevailing type in all seas, and the seas were everywhere. In many places the rocks are almost entirely composed of the remains of these animals. Finally fishes made their appearance. They continued to develop, and have reached their highest phase of specialization at the present time. Then the reptiles came, and at length the mammals. This succession has been marked by a concomitant succession in the relative quantities of animal tissues. When the primeval seas were surcharged with carbonate of lime the organisms then living rapidly used up the excess in secreting protective coverings for their softer parts. In some of the early

Brachiopoda, as Discina and Productus, a calcareous shell made up a large part of their weight. The rugose and tabulate corals, the Cephalopods, and many other forms were permeated through and through with walls and tables of calcareous masonry. This process continued for a long succession of ages. Even when the early fishes appeared they too were plated and shielded by thick secretions of carbonate of lime. But as the type of fishes expanded a new tendency became developed, which has continued to manifest itself ever since. Even the early Ganoids possessed a much greater quantity of soft tissue in proportion to the hard parts than did the Brachiopods and corals. This, of course, was an indispensable prerequisite to the free and roving life which they led. Had they been weighted as heavily as some of the Brachiopods, locomotion would have been out of the question; in fact, it may be enunciated as a general principle that wherever an animal is found capable of vigorous and long-continued locomotion, there we may be sure to find the motile elements of the body sustaining a high ratio to the inert elements. But later on forms like the Cestracionts and other sharks must have had a very large excess of soft parts over hard parts. Later still the heavy ganoid scales were discarded for the lighter ones of the Teleosts. The secretions of lime became less, and the excess of hard parts over soft parts was diminished until the opposite relation existed. While this tendency may not be traceable in all cases, yet there are a sufficient number of instances to warrant the generalization that the development of animal life has been marked by a growing diminution in the quantity of hard parts, and a relative increase in the quantity of soft parts. The gigantic reptiles of the Cretaceous age and mammalian life of later times all point to this conclusion. The change in the relative quantities of hard and soft parts was attended by other correlated changes. As the soft parts were liberated from the incubus of the hard parts they gradually differentiated in various directions, to suit the altered conditions of their environment. By reducing its calcareous integument the animal was more exposed to the attacks of its enemies; and this exposure necessitated one of two things,—either it must take on protective colors or spines, or it must differentiate

motor tissues and organs by which to escape those enemies. In some cases both lines of development have been pursued in some part by the same animal. The locomotive function must certainly have played a highly important part in the life of fishes from the very first, and in birds its manifestations are even more intense. But with the evolution of locomotive powers there arose a need of a system of external or internal leverage, and the result of that necessity is the exoskeleton and endoskeleton of the Arthropoda and Vertebrata respectively. A nutritive apparatus necessarily coëxisted with the lime-secreting activity. But when the factor of locomotion became added to the animal life new differentiations of structure were called into being. Function and tissue reacted again and again in endless combinations, and the present diversities of organic structure were the result. That result was marked not only by qualitative but quantitative peculiarities, and it is these peculiarities that we have been discussing. Such, in brief, is the historical outline.

We now pass on to consider the dynamics of the subject. It is a patent fact that a division of labor is beneficial to all the laboring elements. It is no less true that it results in some degree of dependence between those elements. The degree of the dependence is heightened the farther the specialization is carried. This is eminently true of the animal organism. In its simplest expressions as *Protamœba* an absolute independence between the parts everywhere prevails. All parts alike respond to all stimuli, and no part is anything in particular, but everything in general. In higher forms the structures are more diversified, and they assert their individuality by differential responses to external stimuli. Moreover, each member gives a complete response only when it sustains a connection with all its fellow-members. The several members form a joint society, whose union is strength and whose dissolution is ruin. Such is the polity of the animal body. Now we have seen that the several tissues vary in quantity. They vary in the same individual at different periods of life, and in individuals of equal age in the same and in different species. Such variations in the tissues must profoundly affect the amount of functional activity. Suppose we

compare two of the animals given in the tables, the woodchuck and the rabbit. The ratios of the weight of muscle to the weight of body in the two animals stand in the proportion of 1 : 2. That is to say, the rabbit has two pounds of muscle for every one possessed by the woodchuck, which it can use in moving its body. Now the specific energy of striped muscle in animals as widely separated as the bird and man stand only in the insignificant ratio of 1200 : 1087 ("Animal Mechanism," E. J. Marey), so that we do not feel that we are assuming too great impossibilities when we call the specific muscular energies of the woodchuck and rabbit equal. Now this equality can only subsist for a period of extended duration on condition of equal metabolic activities in the two tissues. These activities, in turn, will depend on the food supply, digestion, and all the preliminary acts of nutrition. But to avoid complications we will adhere to our first assumption. Now the woodchuck has to move twice the inert mass in proportion to its muscular weight as the rabbit. To do this it can execute only one-half the quantity of motion as the rabbit. Then the rabbit leads a life twice as active as the woodchuck. But the viscera of the woodchuck are to those of the rabbit nearly as 3 : 2, and assuming equal nutritive powers in equal weights of the viscera, the difference of muscle weight would be partially offset by a canceling difference in the rates of repair of the wasting tissues. This assumption, however, that equal quantities of viscera repair equal amounts of waste, is not a safe one. Besides, it will be remembered that in these experiments organs as widely diverse in function as the brain, lungs, liver, and heart were, to avoid confusing details, weighed together and classed as viscera.

The rate of assimilation and repair of the muscles would clearly depend upon the size and activity per unit quantity of the organs concerned in the vegetative functions. Organs of different function, as the brain (which is extremely variable in size), would vitiate the comparison between equal quantities of viscera as here employed. But, what is still more adverse to the assumption, there is no good reason for supposing that equal quantities of organs discharging the same functions create equal functional products. Butchers say that in old cows the intestines have a

much greater size in proportion to the body than in young cows and heifers. They are also poorer, and it requires a much greater amount of food to produce a given amount of flesh than in younger animals. This case seems to indicate that the efficiency of the organ degenerates with increasing size. Of course this is not always true, and there are marked instances to the contrary, as in the relatively large brains of certain intellectual prodigies and the heavy biceps of professional pugilists. Probably the differences of size in the functional organs of the viscera are, in many cases, due to the growth of indifferent tissues as fat and connective fibers. Perhaps their presence in the case of the cows already mentioned may even impede the normal discharge of the functions. Be this as it may, it is undeniable that the greater quantities of viscera are by so much an added incubus to the movements of the animal. It is, of course, self-evident that in most cases all the tissues not directly concerned in the contractions which produce motion are in some degree adversative to such contractions. Only a few of the voluntary muscles are used in any one movement, and all the rest of the body is, for the time being, a dead weight to be overcome; so that in the simplest of our daily movements the active and passive parts are continually shifting about, and the waves of maximum activity travel now here and now there. All the tissues, save the voluntary muscles, are perpetually inert relative to movements in the environment. They are at one time impelled to passive movements, and at another time are quiescent, according to the character of the movement. They are in one sense a necessary evil, impeding and yet indirectly promoting the movements of the animal.

Lastly, we have to consider the bones. Without doubt they are inert elements. Yet that very inertness serves a useful purpose in the animal movements. If we compare the ratios of the bones to the body and of the muscles to the body in the woodchuck and rabbit, we are surprised at the absence of parallelism which a knowledge of their mutual connection would lead us to expect. While the muscles of the woodchuck are to those of the rabbit relative to the body as 1 : 2, the bones are nearly equal in the same comparison. This is explained by the fact that the total

weight of body to be supported is greater in the woodchuck, and since the quantity of muscle is relatively smaller, the animal is forced to a sedentary life and does not move about much. Even the forms of body in the two animals harmonize with this view. The woodchuck is stout and heavy, the rabbit is agile and slender. Just as the heavy bones of the woodchuck are indicative of its sluggish habits, so the light bones of the rabbit point to an opposite inference. Very much more could be said of the quantities and dynamical values of the animal tissues, but this must suffice at present. It is hoped that further evidence will be brought forward on some of the points here barely alluded to. The subject is certainly a very fruitful one for future research.

RECORD OF AMERICAN ZOOLOGY.

BY J. S. KINGSLEY.

(Continued from Vol. XXV., page 716.)

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EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

WE have had occasion from time to time to animadvert on the attitude of our government towards the intellectual rights of the people as exhibited by its tariff taxation on scientific and and artistic books and apparatus. After several years of persistent applications to Congress, a committee of the American Association for the Advancement of Science has succeeded in obtaining a remission of the 25 per cent. duty levied on scientific books not printed in the English language. All apparatus, and books printed in English, must still pay the tax. Engravings, photographs, etc., not bound in books must still pay duty. All this means a great deal to the science of the country. The money thus obtained by the United States government comes directly from the pockets of a class whose profession is not remunerative, but whose activity it is of the greatest importance to the country to preserve.

But this exaction does not satisfy the authorities of the treasury department at Washington. To make it more onerous it is now ruled by Secretary Foster that engravings, photographs, and other representations of objects, natural and artificial, are not mailable, but must be sent by express. Fancy this government collecting duties on photographs of minerals, insects, geological sections, etc., made in foreign countries and sent to scientific men in this country for their proper information, and for use in the preparation of scientific memoirs and books. Fancy the corps of men employed at large salaries in inspecting and appraising these matters of which they know so much (!) and add to this the express charges that necessarily exceed those of the post on packages weighing from a half ounce upwards. Add to this the time employed in these examinations and transmissions from hand to hand, and the injury easily done to delicate objects in the process, and we find ourselves wondering whether this is a country of which we ought to be proud or not.

The fact is that the Republican party has made itself odious all over the land by the extreme to which it has carried the idea of protection, and the pettiness of its tariff legislation. (Among the objects recently detained or sold under our tariff laws may be mentioned imported snakes, monkeys and postage stamps.) It is a party that has been of great service to the country, but it is estranging more and more the most intelligent class of our citizens. The Democratic party will have a trial in our next Congress, and we will see whether it will do better or not. It is probable that the intellectual interests of the country will have to fight for existence for many years to come, or until it is better represented in the councils of the nation.

—We are glad to see that Major Powell, director of the United States Geological Survey, has withdrawn his proposed scale of colors for his geological maps, in favor of a more reasonable system. The scheme presented by him to the international congress at Washington was more in accordance with that in general use, and though it did not escape some criticism, it passed the ordeal fairly well. It is cause of just congratulation that the country has been spared an expense of many hundreds of thousands of dollars for geological maps, which would have gone far towards making us ridiculous in the eyes of geologists and their friends. The protest of the Naturalist has wrought such a saving to the government that we feel that we are entitled to some special consideration at its hands; say a subscription which will place a copy on the table of each member of the Senate and House of Representatives *in perpetuum.*

—Considerable progress has been recently made in the discovery of the phylogeny of man, two steps of which are noticed in the present number of the Naturalist. In the first place, the men of Spy (Belgium) described by MM. Lohest and Fraipont, of Liége, constitute a well-marked ancestral type within the genus Homo. The Neanderthal skull, represented by a calvarium only, was for a long time without corroborative support as the representative of a race of man, and it was hence supposed by some persons to have belonged to an idiot or a

monster. The discovery of similar crania near Cannstadt, Würtemberg, rendered it certain that the type was widely distributed in Europe, and was not a mere anomaly, and it received the name of the Canstatter race. A lower jaw which presents some simian characters was found at Naulette, Belgium; but as the lower jaw of the Canstatters had not been found, its probable relation to this race could not be proven. The two nearly complete skeletons of Spy have completed the evidence as to the characters of the race. Not only does the lower jaw of Naulette belong to it, but some of the parts of the skeleton display characters more distinctly simian than any known race. The tibia is distinctly shorter than is characteristic of other men, and the femur is curved anteroposteriorly, as in the chimpanzee. Taking it altogether, the Canstatter race answers the expectations founded on theory as to what an ancestral type of man ought to be. Distinct traces of it are said to have been found also in Bohemia France.

The senior editor of the NATURALIST has expressed the view that the anthropoid apes and man were probably descended from the anthropoid lemur Anaptomorphus, without passing the intervention of the true monkeys of the Old-World type (Cercopithecidæ). Probable confirmation of this view has been recently brought forward by M. Ameghino, of Buenos Ayres, in the discovery of a new species of a new genus of quadrumanous mammal from Patagonia, which he calls *Homunculus patagonicus*. At first regarding it as an anthropoid lemur, M. Ameghino now places it in the Simiidæ or Old-World monkeys; but whether he means by this the anthropoids or the true monkeys, is not yet clear. It is, however, apparently intermediate in the characters of the skull and teeth between the lemurine Anaptomorphus and the anthropoid apes, with some human dental characteristics found in the former. From any point of view, the discovery of M. Ameghino is of high importance, since neither lemurs nor Old-World monkeys have been hitherto met with in the fossil or recent state in South America.—C.

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RECENT LITERATURE.

Doelter's Allgemeine Chemische Mineralogie[1] is a collection in logical order of all those facts relating to the chemistry of minerals that are so interesting to the modern mineralogist. After discussing crystal structure in its relation to the chemical molecule, and defining isomorphism, isomerism, polymorphism, and isoganism, and briefly touching upon morphotropism, the author describes the ordinary methods of chemical analysis, and then occupies about seventy pages in a treatment of the subject of mineral synthesis. It is this latter portion of the volume that is most interesting. The author is himself such an indefatigable worker in this line of investigation that his remarks on the manufacture of minerals must be accepted as worthy of great confidence. Everywhere in these pages he writes himself master in his chosen study. He distinguishes clearly between terms that seem to approach each other in meaning, and defines them in such simple language that they need no longer be misunderstood. He divides the subject into two parts,—viz., the recrystallization of mineral substances already prepared, and the production of minerals and their crystallization. Under each head the methods that have proven most satisfactory for the purposes desired are given in detail, and following these is a brief but sufficiently full account of experiments that have yielded mineral products, with references to the articles in which they are described. Nearly every synthesis that has ever been made may be traced by the aid of the book,—a feat that has heretofore been possible only with the greatest difficulty. The last three parts of the volume deal with the chemical changes effected in minerals by change in temperature and by the action of solvents, the formation of minerals in nature, and the chemical composition and constitution of minerals.

Though the book is not as complete as is Lehmann's Molecular Physik in its treatment of those subjects that both discuss in common, it serves as a supplement to Lehmann's wonderful production, and demands a place beside this in every mineralogist's library.—W. S. B.

Fewkes's Cœlenterates and Echinoderms.[2]—Dr. Fewkes has presented the New England student of the old group of Radiates a

[1] Leipzig, 1890, pp. 278, illus. 14.

[2] An Aid to the Collector of the Cœlenterata and Echinodermata of New England. By J. Walter Fewkes. Bulletin Essex Institute, Vol. XXIII., pp. 91. Salem, 1891.

handy aid to the identification of the more common littoral and pelagic species. First comes an account of the methods of collecting (not a word concerning modern methods of preserving specimens), and then the synopsis of the forms enumerated, something after the fashion of an analytical key. Numerous original figures will aid the student in his identifications. The arrangement of the divisions recognized is hardly up to date, and in some cases it is open to serious criticism. Thus, for instance, Dr. Fewkes associates the Ctenophores with the Hydrozoa as a subdivision ("order"), equal in rank to the Trachymedusæ (!) The recent important conclusions as to the position of the Scyphomedusæ are ignored. The manubrium is defined as "a fleshy protuberance of folded membrane"; by implication the Ctenophores (p. 13) would be included in the naked-eyed Medusæ; the Madreporaria (p. 55) are made to include Pennatulacea, Gorgonacea, and Alcyonacea (?), while (p. 57) the Alcyonacea are placed under the Gorgonacea, etc. We have been moved to these comments from the fact that beginners are likely to use this in the identification of their specimens, and may thus obtain erroneous ideas of relationships. The lapses are too numerous for a man with Dr. Fewkes's extensive knowledge of the group. The concluding portion of the paper, which consists of a list of times of occurrence of marine larvæ at Newport, is the most valuable part of it.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Californian Cave Bear.—In the NATURALIST for 1879, page 791, I described a species of bear, previously unknown, which was represented in my collection by a nearly complete skull. The specimen was found in a cave in Shasta county, California, and was in excellent preservation at the time of its discovery, but it had suffered from the ill usage of curious persons. The rami of the lower jaw had been given away and lost, the zygomata had been chopped off, and the canine teeth broken away. The remaining cranium is, however, a fine specimen, and was originally partially covered by stalagmite. A large part of this has been removed, enough being left to demonstrate its geological position.

The species was named *Arctotherium simum* Cope. It possesses several points of interest. In the first place it is nearly related to the bear of the Pampean epoch of South America, *Arctotherium bonærense* Gervais, which is found in Argentine in association with the remains of gigantic sloth Toxodonts, Glyptodonts, etc. It differs from its Pampean ally in several important respects. The muzzle resembles that of the latter in its extreme brevity, so that both alike were "pug-nosed," in great contrast to the existing bears. The relative proportions of the remainder of the skull are markedly different in the two species, being more elongate in the *A. simum* than in the *A. bonærense*. The penultimate premolar, as in the latter, is two-rooted, but it stands in line with the dental series, and not oblique to it and overlapping the other premolars, as in *A. bonærense*, a character which results from the greater abbreviation of this part of the maxillary region in the latter species. There is also a large median third incisive foramen in the Californian species, which is wanting or very small in the Argentine.

As compared with the species of true bear (genus Ursus) the Californian cave bear presents many peculiarities apart from the characters which distinguish the genus Arctotherium. While the proportions of the posterior part of the skull are much as in the true Ursi, the anterior portion is much shorter and wider. The palate and forehead are half as wide again as in the grizzly (*U. horribilis*), or the European cave bear (*U. spelæus*), and the front is much more convex. It is not only con-

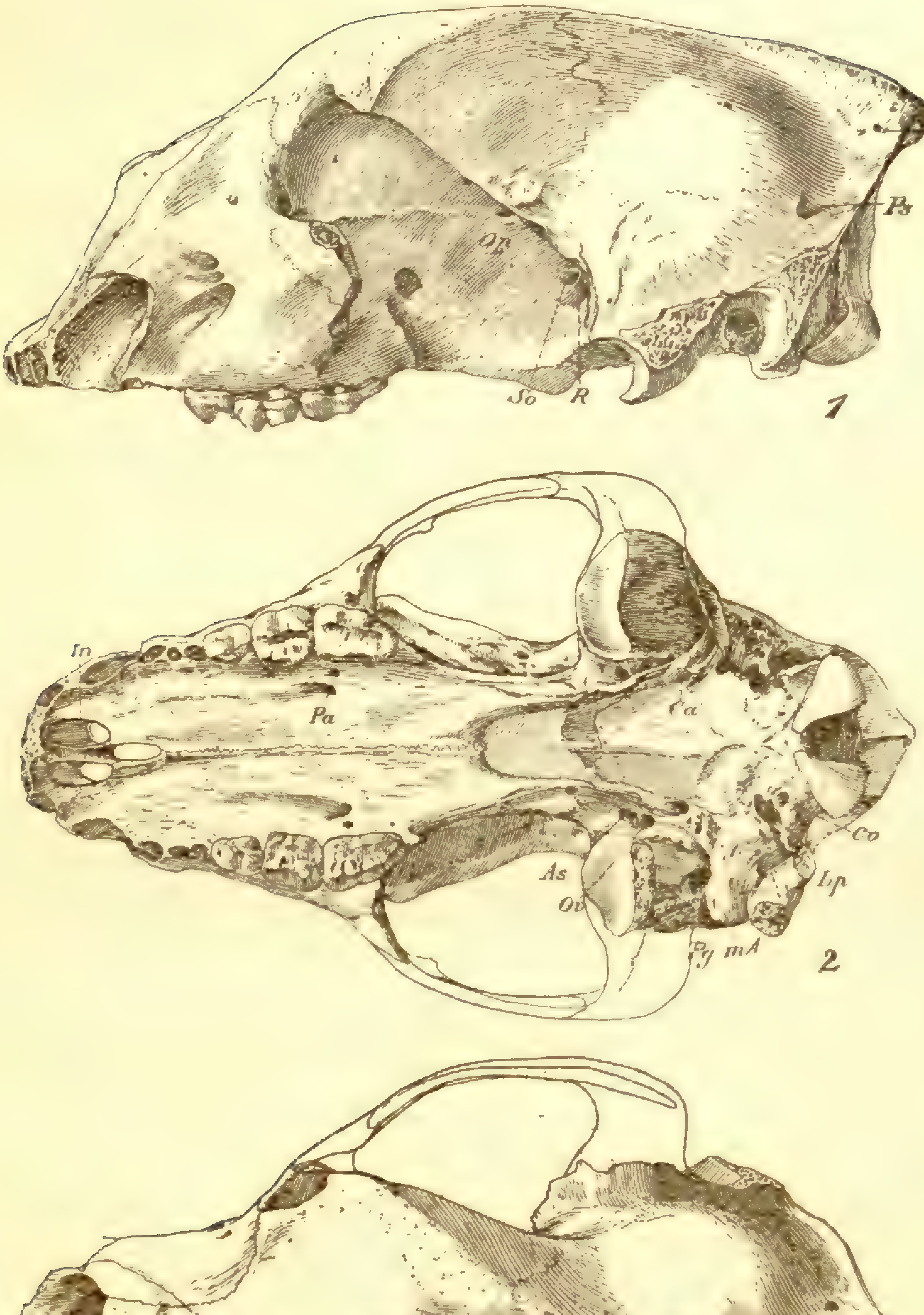
vex anteroposteriorly, as in the *U. spelæus*, but it is regularly convex transversely, which it is not in that species. The two species of Ursus named have relatively larger molar teeth than in the other species of the genus, but in the Californian cave bear they are relatively still larger, and especially broader, having a swollen area between the tubercles not recognizable in the m. I. in those species, and but feebly in m. II. The canines are also relatively larger, judging from the size of their alveoli. Another peculiarity is the presence of three infra-orbital foramina. Ameghino[1] represents two in the *A. bonærense*.

In dimensions this skull equals that of the largest grizzly bears, and the average of the European cave bears. Some of the latter exceed it in length, but the form in the *A. simum* is more robust than in either of those species. To judge by the skull alone, the Californian cave bear was the most powerful carnivorous mammal which has lived on our continent. Its short nose and full rounded forehead must have given it a peculiar physiognomy. The living mammal which approaches nearest in general appearance is probably the rare black-and-white bear of Thibet, the *Æluropoda melanoleuca* of Milne-Edwards, which connects the Arctotheria with the extinct Hyænarctos of the Neocene ages. It was a much larger animal than the *A. melanoleuca*. Unfortunately we can form no idea as to the color of its fur.

Like its South American congener, the Californian Arctotherium was associated with gigantic sloths (Mylodon), and it belongs to a fauna which has left in other localities in North America Megatheriums and Glyptodonts. In other words, it is one of the forms which justify the statement which I have made elsewhere (Proc. Phila. Acad., 1867, p. 156; Proc. Amer. Philos. Soc., 1871, p. 99), that during the late Pliocene or early Plistocene an invasion of Mammalia from the south took place. I have suspected that this invasion originated after the north had been covered by an ice sheet which prevented immigration from Asia and permitted it from the south, since no predecessors of the southern types of Mammalia had been found at that time in older North American horizons. Since that was written no ancestral forms of the Megatheriidæ and Arctotherium have been found, but ancestors of several other members of the South American fauna have been discovered. Thus a genus of Glyptodontidæ (Caryoderma Cope) has been found in the Upper Miocene (Loup Fork) of Kansas; and a primitive type of peccaries (Bothrolabis Cope) has been obtained from the middle Miocene (John Day) of Oregon. Primitive forms of tapirs occur in the Upper Miocene (Loup Fork; genus Tapiravus Marsh).

[1] Mamm. Foss. Argentinos, Pl. III., Fig. 1.

PLATE XXI.



Arctotherium simum Cope; ⅓.

It has been assumed that South America received its llamas and horses from North America on abundant evidence; and it is now probable that she received the tapirs and peccaries from the same source, since no early types of these lines have been revealed in South American formations by recent extensive researches in that continent. Sloths and Glyptodons are, however, shown by these investigations to have existed in South America during the Eocene period, so that our primitive Glyptodont and Caryoderma may have been an early immigrant from that continent, while the sloths came later. As regards bears, it is well known that we have not found their ancestral types in either of the Americas, but that they are abundantly found in the Neocenes of Europe and India. Arctotherium is both the earliest and most primitive form which we possess, and the time of their appearance is the same in both North and South America. They probably reached this continent at a comparatively late date, but earlier than the arrival of the true genus Ursus. Between the two genera occurs the Tremarctos, of which one species exists still in the Andes, *T. ornatus* Cuv., and one exists in the fossil state, *T. etruscus*, in Europe (Cuvier, Oss. Fossiles, Pl. 189, Fig. 8). This indicates the possible origin of the genus Ursus on the American continent, as well as on that of Eurasia; but prior to Arctotherium America has nothing, while Eurasia has everything.—E. D. Cope.

Explanation of Plate.

Skull of *Arctotherium simum* less than one-fifth natural size, linear.

Fig. 1, profile; 2, from below; 3, from above.

Foramina: In., incisive; Pa., palatine; Op., optic; So., sphenoörbital; R., rotundum; As., alisphenoid; Ov., ovale; Pg., postglenoid; Ca., carotid; MA., meatus auditorius externus; Lp., lacerum posterius; Co., condylar; Ps., postsquamosal; Op., postparietal.

The Work of White Ants in Australia.—In a recent paper on Central Australia, published in the Proceedings of the London Geographical Society, June, 1891, Mr. Charles Chewings quotes Mr. Woodward as authority for the statement that extensive alterations in the surface of the country are due to the industry of the white ants. Mr. Woodward has traveled over a large part of Australia, and he has had the especial advantage of examining the so-called desert sandstone formations, to the disintegration of which we attribute those endless sandhills that have been so often described as a dessert, but which cannot be strictly so called, since this sandy land is covered, often very thickly, with trees and shrubs. He is of the opinion that a

"great deal of work is done, vastly altering the appearance of the country, by what may appear to many people at first sight a perfectly ridiculous agency,—viz., the white ants; but after passing over the plains or through the thickets, where their hills are so numerous that it is difficult to drive through them, the immense amount of their work can be better appreciated. The clay, cemented with resinous matter, with which they build their nests is as hard as brick, and when these fall to pieces they form clay flats almost impervious to water, and so hard that they will bear a great deal of traffic without being cut up. The work of these creatures can be studied in all stages: first in the thickets where they are commencing work; then in the more open country, where they have got the upper hand of the timber; next on the plains, where half the hills will be found deserted; and lastly on the clay flats, where they have almost entirely disappeared and the scrub has begun to grow again. Another remarkable thing about these nests is the amount of iron they contain, for when a tree has been burnt in which they have built a nest there will be found at its base a mass of iron clinker, looking just as if it had come out of a furnace."

More New Mammalia from the Eocene of Patagonia.— M. F. Ameghino describes in a new extract from the *Revista* for August, 1891, the results of the last exploration in Patagonia of M. C. Ameghino. These consist of no less than 173 species of Mammalia, by far the greater number of which are new to science.

The most interesting novelty described is a new species of a new genus of Quadrumana, which has the dental formula of the Old-World monkeys, with especial resemblances to that of man. This is seen especially in the small canine teeth, which are not followed by a diastema. This genus accentuates the proposition which I have advanced, that the line of the Anthropoid apes and man has been derived directly from the Anthropoid lemur Anaptomorphus of the Eocene period. The *Homnuculus patagonicus*, as this remarkable form is called by Ameghino, certainly has considerable resemblance to the former genus, but is more like the true monkeys in its quadritubercular lophodont molars.

The Mammalia described are referable to the following orders:

Marsupialia (?)		38
Edentata		62
Glires		23
Bunotheria	(Insectivora)	1
	(Creodonta)	8
Taxeopoda	(Litopterna)	23
	(Quadrumana)	1
Toxodontia		13

Among the important discoveries are the numerous ? Marsupialia. Several of these belong to the genera allied to the Plagiaulacidæ already described by M. Ameghino. The author has discovered a fact long since (AMERICAN NATURALIST, 1884) pointed out by myself,—viz., that the cutting inferior molar of the Plagiaulacidæ is not homologous with the cutting tooth of the mandible in the Marsupialia Diprotodonta, but is one position posterior to it. I regarded it as the P. m. i. (iv.), but Ameghino, following Thomas's nomenclature, regards it as the m. i. Garzonia g. n., Epanorthus, and Microbiotherium are made types of new families with apparent reason. So is Abderites, but no sufficient ground appears to be given in its case. Three new genera and seven new species are referred to the existing family Thylacynidæ, thus bringing to light the lost relatives of the Tasmanian wolf-opossum. An affinity between these animals and the Creodonta of the same age is insisted on.

In a previous essay Ameghino shows that Propalæhoplophorus has distinct vertebræ, and represents therefore a family entirely distinct from the Glyptodontidæ. Cochlops belongs to the same family. He adds much to our knowledge of Peltephilus, which M. Mercerat declares to be identical with Cochlops. Family names appear to be rather carelessly used among the Glires ; there are too many of them. Among Litopterna, Mesorhinus Amegh. is made the type of a new family, which has the external nares placed more anteriorly than in the Macraucheniidæ ; he includes in it the genera Mesorhinus, Oxyodontotherium, Cœlosoma, Theosodon, and the new Pseudocœlosoma. Several important points in the structure of Homalodontotherium are added ; among the rest, that it has an ungrooved astragalar trochlea. A new species is described, and a new genus (Diorotherium) is added to the family. Eleven new species are added to the Proterotheriidæ. Astropotheriidæ are still referred to the Amblypoda Taligrada, and a new genus (Astrapodon) is added. Many striking novelties are added to the Toxodontia.

This contribution increases our interest in this wonderful fauna, and leads to the hope that we shall soon see the illustrations of some of the forms already promised by M. Ameghino.—E. D. COPE.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The gabbros of the United States, which, until a few years since, were scarcely known, have recently been studied in typical regions. Prof. Chester[2] has lately communicated the results of his study of the great belt of these rocks crossing the northern part of Delaware and running southwesterly until it unites with that investigated by Williams in the Baltimore area. The rocks of the Delaware region differ from those of the Maryland area in that the former very frequently contain quartz. The normal rock is a hypersthene-gabbro, containing brown hornblende and biotite. This graduates into a more acidic phase by an increase in quartz, and at the same time an equally noticeable gain in biotite, until it becomes more properly a pyroxene-granite than a gabbro. On the other hand, by the increase of brown hornblende, regarded as original, and the assumption of a schistose structure, the normal gabbro grades into a gabbro-diorite or a hornblende-gneiss. Further, uralitization of the pyroxene gives rise to green schistose rocks, identical in nearly all of their characteristics with the gabbro-diorites of the Baltimore region. The author describes in detail each type found by him, and gives analyses of the feldspars of many of them. The plagioclase of the typical diallage-hypersthene gabbros is Ab_1An_2, while that of the more acid biotitic rock is Ab_3An. Gabbro-diorite is the name given to the schistose rock in which brown hornblende predominates over pyroxene. Since the hornblende is regarded as original, there would seem to be no sufficient reason for not calling the rock a diorite-schist, thus reserving gabbro-diorite for those schistose phases of gabbro in which the hornblende is largely secondary. By the loss of nearly all of their pyroxene the gabbro-diorites of both classes pass into hornblende-gneisses. In the gabbro-granites, derived from the gabbros by an increase in quartz and biotite, there are evidences of pressure action in the shattered condition of the quartz and feldspar. Norites, described by the author, are aggregates of quartz and feldspar, in which are imbedded phenocsyts of hypersthene. ——Messrs. Campbell and Brown[3] add two new varieties to the Triassic traps of Virginia, differing from those described from more northern localities in that they contain hypersthene. One is a hypersthene-

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Bull. U. S. Geol. Sur., No. 59.

[3] Bull. Geol. Soc. Amer., Vol. II., p. 339.

diabase, and the other an olivine-hypersthene-diabase. The latter has been found only in one place,—viz., two miles north of Rapidan Station on the Virginia Midland R. R. The hypersthene-diabase occurs not only in various places in Virginia, but it has also been found north. It is slightly ophitic, inclining somewhat to the porphyritic. Its feldspar is a basic labradorite of the formula Ab_2An_5. The pyroxenes are a slightly pleochroic, polysynthetically twinned diallage, and a strongly pleochroic hypersthene. The former contains numerous microlitic inclusions, while the latter is free from them. Quartz, apatite, and green hornblende are accessories. In the olivine rock the olivine is largely idiomorphic, and is in large grains. The other constituents are the same as those of the hypersthene-diabase. The paper contains an excellent series of analyses of the rocks and their most important components.——Barrois[4] has given us a masterly discussion of the diabases and diabase-porphyrites of Silurian age, occurring as dykes and flows in Menez-Hom, Finistère, France. The diabases he divides according to structure into granular and ophitic types. Among the former are olivine-bearing varieties, sometimes containing hypersthene, and olivine-free kinds, containing orthoclase, quartz, and occasionally porphyritic augite. The porphyrites are divided into andesitic varieties in which the feldspar-microlites are older than the augite, and into variolitic kinds with feldspar younger than augite. A large part of the rocks of the region studied occur in the form of tuffs, in which the cementing material is shale, limestone, or sandstone, and the fragments are sometimes large enough to be called bombs. Schalstein is also common. The contact effects noticed in the eruptives are insignificant in amount. The schists in contact with the bedded diabases are spilosites, containing nodules of chlorite. The most interesting contact effects are those noticed in the case of nodules originally consisting of pyroxene and quartz. Under the influence of sea-water made hot by submarine ejections, these nodules have become zonal, in which the two zones differ principally in the size of their constituents, as both contain pyrite, albite, quartz, sphene, and limonite. In conclusion, the author makes some general remarks on the study of ancient volcanoes, and gives quite a good résumé of the work done in this direction.——A dyke of basic rock on Stop Island, in Rainy Lake, Canada, consists of diabase-porphyrite with an almost aphanitic texture on its contact. It contains occasional rounded masses of augite. Four feet from the contact it is a diabase, with the ophitic texture, and at fifteen feet from the contact it is also a diabase. Here, however, a

[4] Bull. Serv. Carte Geol. d. Fr., No. 7, 1890.

portion of the augite is in idiomorphic crystals and in polysomatic grains, while another portion is in allotriomorphic masses between the feldspars. In the middle of the dyke the texture is gabbroitic, while hornblende replaces the augite. Quartz is also a prominent constituent of the center of the dyke, whereas it is only sparingly present at fifteen feet from the contact, and is entirely absent at the contact. Dr. Lawson [5] calls attention to these facts, and states that in the single geological unit represented by the mass of the dyke we must distinguish between three distinct rock types if we make use of present methods of nomenclature. He further thinks that the phenomena indicate that rate of cooling, rather than pressure, is the principal cause determining the textural condition assured by a solidifying magma. Other dykes exhibiting similiar pecularities are described from other localities in the Rainy Lake region. All show larger percentages of SiO_2 in their middle portions than are shown near their contacts,—a fact ascribed to the separation of basic augite, magnetite, etc., in those portions that cooled rapidly.——The larger part of the area of the Dippauer Gebirge in Northwestern Bohemia is covered by basalts, occurring in flows, dykes, and bosses, with their tufas and conglomerates. These are cut by phonolites and andesites, in the former of which are large grains of perofskite, in some cases showing parallel striations in parallel light. The basalts occur in all varieties, according to Clements.[6] The central portions of the hills are composed principally of leucite and nepheline basalts and the closely related rocks, nephelinites, leucitites, nepheline and leucite tephrites, and leucite-basanites. On the peripheries of the mountains are feldspathic basalts, limburgites, and augites. Among the most interesting features of the several rocks noticed are corroded biotite plates, surrounded by rims formed of secondary crystals of the same mineral, in the nepheline basalts; pseudomorphs of phillipsite after olivine in the leucitites; augite crystals with secondary twinning lamellæ produced by pressure in the nephelinites and feldspathic basalts; zonal augites in the leucitites, with an extinction varying gradually from the center to the periphery, and others with the hour-glass structure and an outer zone containing colorless microlites with their long axes lying parallel to the bounding walls of the crystals; and sanidine inclusions surrounded by augite crystals in leucite basalt. Leucite is more abundant in close proximity to an orthoclase inclusion in the last-mentioned rock than elsewhere in the rock-mass. Of the feldspathic basalts it was found that the youngest is most acid.——

[5] *Amer. Geol.*, VII., 1891, p. 153.

[6] Jahrb. d. Kais-Kön. geol. Reichsanst, 1890, XL., p. 317.

Dr. Wolff[7] calls attention to the existence of ottrelite and ilmenite schists among the Paleozoic crystalline rocks of the Taconic region in the Green Mountains and in Massachusetts and Rhode Island. The Rhode Island rocks comprise micaceous schists and graywackes. In the former are grains of quartz, scales of muscovite, and occasional small patches of chlorite and bands of a mixture of graphite and ilmenite. Ottrelite crystals are scattered indiscriminately among the other constituents. In the graywacke the ottrelite occurs in irregular plates, which are free from optical deformities, while the other components of the rock give evidence of having been subjected to intense pressure. Even the mica, which owes its presence to metamorphic agencies, is bent and twisted. The absence of optical deformities in the ottrelite points to a very late origin for this mineral. The author also briefly describes a graphite-schist with ilmenite plates from Rhode Island. All the Rhode Island rocks are known only in boulders.——Singaelia[8] describes specimens of glassy lava from Vesuvius in the cabinet of the University of Berlin. Those from the streams of 1753 and 1809 consist largely of glass in which are tiny perfectly formed crystals of leucite and olivine and good crystals of augite and plagioclase. Other leucites are skeleton crystals, with their edges sharply defined, but their faces hollow. Two other specimens contain glassy portions between crystalline portions. Of these, one from the flow of 1822 contains hornblende, and another, whose age is unknown, has its anorthite and other crystals surrounded by rims of little rutile needles.——The ophiolites of Essex Co., N. Y., and the serpentines from Aqueduct Shaft No. 26, New York city, and from near Easton, Pa., have resulted by metasomatic changes from pyroxene, according to Merrill.[9] In the first-named rock the larger part of the serpentine, which is light green in color, is from a colorless pyroxene. Small particles of a darker-colored serpentine are scattered through the rock, and in these are enclosed graphite scales. Thin sections of these portions show them to consist of calcite, dolomite and serpentine. Originally they were probably composed of the first two minerals only. The serpentine is a subsequent formation, but by what method it was produced the author has not succeeded in determining.——A remarkable example of a Huronian volcanic tufa, from the nickel region at Sudbury, Canada, is reported by G. H. Williams[10] as composed of a glass breccia

[7] Bull. Mus. Comp. Zool., XVI., No. 8, p. 159.

[8] *Neues Jahrb. f. Min.*, etc., B.B. VII., p. 417.

[9] Proc. U. S. Nat. Mus., XII., p. 595 ; Washington, 1890.

[10] Bull. Geol. Soc. Amer., Vol. II., p. 138.

with its original flowage structure and the shapes of its included fragments well preserved through silicification. Calcite, glassy feldspar, and chlorite are the only minerals, with the exception of quartz and chalcedony, that can still be detected in the rock.——In a report on the iron ores of Minnesota,[11] by Messrs. N. H. and H. V. Winchell, Dr. Hensoldt describes a few of the rocks associated with the ores. Among them are various green schists, jaspers, chalcedony, etc.

Mineralogical News.—*American Minerals.*—Within the last few months a large number of articles have appeared containing the results of investigations of American minerals. Prof. Genth[12] reports some analyses of interesting minerals from the United States and Mexico. Bladed crystalline masses of *tetradymite* from Bradshaw City, Yavapai Co., Ariz., consist apparently of orthorhormbic plates, whose composition corresponds to $Bi_2(S_{1/3}Fe_{2/3})$ [Bi = 62.23; S = 4.50; Fe = 33.25]; so that in all probability the mineral belongs in the stibnite group. *Ziron* from Mars Hill, Madison Co., N.C., yielded him: SiO_2 = 31.83; ZrO_2 = 63.42; Fe_2O_3 = 3.23; Loss = 1.20. Its specific gravity is 4.507. Small crystals of *scapolite* associated with garnet at Elizabeth Mine, French Creek, Pa., gave:

SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	CO_2	Loss	Sp. Gr.
52.30	23.68	.58	.05	12.36	6.29	.77	2.63	1.50	2.675

Both minerals appear to be alteration products of essonite. The garnet is brownish-gray or ash-gray in color. Its composition is given opposite (I.). A titaniferous variety, from the Jones Mine, Henderson Co., N. C., has a composition as opposite (II.):

	SiO_2	Al_2O_3	Fe_2O_3	FeO	Mgo	CaO	MnO	TiO_2	CO_2	Loss	Dens.
(I.)	41.42	18.09	10.81		.59	26.19	.88		1.71	.51	3.390
(II.)	35.56	4.43	20.51	1.88	.17	31.90		4.58		.55	3.738

Analysis of *pyrite* from French Creek, Pa., and of *allanite*, are also given in the same paper. The green substance associated with the gold at Los Cerillos, N. M., supposed to be turquoise, was found in one instance to be *chromiferous clay*, and in another to be *cupriferous quartz*. Pseudomorphs of the latter mineral after stibnite are mentioned by the author as occurring at Durango, Mexico. In another article Prof. Genth[13] gives the result of an examination of *lettsumite* from the Cop-

[11] Bull. No. 6, Nat. Hist. and Geol. Survey of Minn., p. 429.

[12] *Amer. Jour. Sci.*, August, 1890, p. 114.

[13] Ib., p. 118.

per Mountain Mine, near Morenci, Arizona, and from the American Eagle Mine, Copperopolis, Utah. In the first-mentioned locality, the substance forms incrustations of small, blue, fibrous tufts in a quartz gangue. Upon alteration it gives rise to a greenish-yellow, and finally to a fibrous yellowish-white material, often associated with hydrous aluminium sulphate. The Copperopolis specimens are velvety coatings of azure-blue silky fibers on a mixture of clay and lettsumite. The analyses of the two varieties, which are almost identical in composition, lead to the formula $Cu_4Al_2(OH)_{12}SO_4 + 2H_2O$.

SO_3	CuO	Al_2O_3	Fe_2O_3	H_2O	Ins.	Sp. Gr.
12.49	46.71	16.47	1.34	21.89	.44	2.737

——Crystallized *metacinnabarite* (which has heretofore been found only in amorphous masses) has recently been discovered in the New Almaden Mine, California.[14] The crystals are implanted on quartz containing cinnabar crystals, which in turn occurs incrusting a selvage of clayey material forming an ore seam, whose origin is referred to solfataric action on the country rock. Spheres of a black organic substance are imbedded in the metacinnabarite, whose density is 7.118. Its composition follows:

S	Hg	Fe	Co	Zn	Mn	$CaCO_3$	Quartz	Org. Matter
13.68	78.01	.61	tr.	.90	.15	.71	4.57	.63

The crystals are rhombohedral and hemimorphic, with an acute pyramidal habit, and an axial ratio $a : c = 1 : .2372$.——In rotted galena on a contact between limestone and mica-schist at Mountain View Lead Mine, near Union Bridge, Md., Williams[16] has found small but good crystals of *anglesite* and *cerussite*, and a single crystal of *sulphur*, all of which are products of the decomposition of the lead ore. The three principal types of the anglesite are prismatic, parallel to the brachy-axis, with $P\breve{\infty}$ and $P\breve{2}$ predodominating, cuboidal, with $P\breve{\infty}$ and $\infty P\bar{\infty}$ the principal forms, and prismatic in the direction of the macro-axis, with $\frac{1}{4}P\bar{\infty}$ determining the habit. The cerussite presents a great variety of habits. One elbow twin is peculiar in that each of the two individuals is bounded on the inner side by $\infty P\breve{\infty}$, while the outer side contains in addition the brachy-domes $\frac{1}{2}P\breve{\infty}$, $P\breve{\infty}$, and $2P\breve{\infty}$. The sulphur crystal is very small, but it contains thirteen forms, of which eight are in the zone of the ground-pyramid and one $\frac{3}{8}P$ is new. ——The *polycrase* reported by Messrs. Hidden and Mackintosh[16] as oc-

[14] Melville. Ib., Oct., 1890, p. 291.

[15] Johns Hopkins Univ. Circ., No. 87.

[16] *Amer. Jour. Sci.*, June, 1890, p. 302.

curring four miles from Marietta, S. C., and in Henderson Co., N. C. has been examined by these gentlemen, who find it forming tabular crystals with $\infty P\breve{\infty}$ largely developed, and the new forms $0P$, $\frac{1}{3}P\breve{\infty}$, and $\breve{P}\frac{3}{2}$ occurring on it. Several of the crystals are apparently twins, and those from South Carolina, when doubly terminated, appear to be both hemihedral and hemimorphic. The material for analysis was obtained by washing kaolinized coarse granite. This, when corrected for impurities, yielded:

	Cb_2O_5	TiO_2	Y_2O_3 (etc.)	FeO	UO_3	PbO	Fe_2O_3	CaO	H_2O	Ins.	SiO_2
N.C.	19.48	29.31	27.55	2.87	13.77				5.18		
S.C.	19.37	28.51	21.23	2.47	19.47	.46	.18	.68	4.46	.12	1.01

Prof. Rowland, to whom the South Carolina specimens were submitted for microscopic study, found in them large amounts of scandium.——The same investigators[17] have examined lemon-yellow *auerlite* from Price's Land, Henderson Co., N. C., and a few other rare minerals. The auerlite has a density of 4.051–4.075, and a composition: $P_2O_5 = 8.58$; $SiO_2 = 6.84$; $ThO_2 = 72.16$ (diff.); $Fe_2O_3 = 1.78$; $H_2O = 10.64$. *Sulphohalite* they find to be probably tetrahedrally hemihedral. The *fayalite*[18] of Cheyenne Mt., Colorado, occurs sometimes in the granite in masses weighing as much as ten pounds. Analysis: $SiO_2 = 27.66$; $FeO = 65.79$; $MnO = 4.17$; $CaO = .47$. Mr. Hidden[19] also announces the discovery of *bastnaesite* and *tysonite*, near Manitou, Colorado, in a mass weighing over six kilograms, and gives four new localities for the occurrence of *fergusonite*, as follows: Associated with allanite, at Amelia Court House, Virginia; accompanying zircon, in the mines at Storeville, Anderson Co., South Carolina; at the Grassy Creek Mica Mine, in Mitchell Co., N. C.; and in the gold placers near Golden, Rutherford Co., N. C. The *orangite* of Landbö, Norway, is declared to be *uranothorite*. Its density is 4.322. A partial analysis gave 11.97 per cent. H_2O; 18.50 per cent. SiO_2; 52.53 per cent. ThO_2; 9 per cent. UO_3, and small quantities of other substances.——Associated with beryl and spodumene in the granite of the Nickel Plate tin claim, in Pennington Co., South Dakota, are nodules of a phosphate near *triphyllite* in composition. It is dark green in mass, and light yellowish-green in thin splinters. Its hardness is 5, and density 3.612. Analysis[20] yielded:

P_2O_5	FeO	MnO	CaO	MgO	Na_2O	K_2O	Li_2O	F	Ign.	Gangue
38.64	25.05	15.54	5.53	1.50	7.46	2.00	.28	.69	.73	2.47

[17] Ib., May, 1891, p. 438.

[18] Cf. *Amer. Jour. Sci.*, March, 1885, p. 25.

[19] Ib., p. 439.

[20] Headdon. *Amer. Jour. Sci.*, May, 1891, p. 416.

——Penfield[21] has analyzed an *aurichalcite*, occurring in narrow seams in an impure limonite from Utah, which yielded an average:

CO_2	CuO	ZnO	H_2O	CaO	Dens.
16.36	19.37	53.09	9.92	.61	$3.57 = 2RCO_3 3R(OH)_2$,

in which R = Zn and Cu, with CuO:Zno = 2:5.——Inexhaustible beds of *beauxite* have been discovered near Little Rock, Arkansas, and near Benton in the same state. According to Branner[22] they are genetically related in some unknown way with eruptive granites. The material is pisolitic in structure. A partial analysis of one specimen gave: $Al_2O_3 = 55.64$; $SiO_2 = 10.38$: $Fe_2O_3 = 1.95$; $TiO_2 = 3.50$; Loss = 27.62.——An analysis of *halotrichite* from Pitkin Co., Colorado, is given by Bailey[23] as follows:

SO_3	Al_2O_3	Fe_2O_3	FeO	MgO	H_2O at 100°	H_2O at over 100°
33.46	12.98	1.60	5.18	.17	33.10	12.94

——Farrington[24] has carefully examined the Arizona *azurites*, on which he finds the new forms $\frac{2}{3}P$, $\frac{4}{7}P$, $3P\frac{3}{2}$ and $\frac{12}{5}P\frac{6}{5}$. Four distinct types of crystals are recognized; one is pyramidal with 2P predominant. The others are prismatic, dome-like, and lath-shaped. The latter came from the Longfellow Mine, and are peculiar for their ortho-diagonal elongation and the large development of the orthodome $P\overline{\infty}$. The axial relation calculated from the measurements of the different types is $a : b : c = .85676 : 1 : .88603$; $\beta = 87°36'36''$——The very rare mineral *pollucite* has just been reported by Wells[25] as associated with quartz crystals aud clay, and with psilomelane and a nearly colorless calcium beryl at Hebron, Maine. The pollucite is in irregular fragments, perfectly colorless, and as brilliant and transparent as plate glass. Its index of refraction for sodium light is 1.5247, and its density = 2.976–2.985. Its analysis gave:

H_2O	SiO_2	Al_2O_3	CaO	Cs_2O	K_2O	Na_2O	Li_2O
1.50	43.51	16.30	.22	36.10	.48	1.68	.05

corresponding to $H_2R'_4Al_4(SiO_3)_9$, with which formula all the analyses of the Elba mineral may likewise be made to agree.——*Columbite*[26] crystals from the Bob Ingersoll Claim and the Etta Mine in the Black Hills have a tabular habit with $\infty P\overline{\infty}$ predominating.——Snow[27] reports the occurrence of *turquoise* at several ancient workings near Silver City, Grant Co., New Mexico.

[21] Ib., Feb., 1891, p. 105.
[22] *Amer. Geol.*, VII., 1891, p. 181.
[23] *Amer. Jour. Sci.*, April, 1891, p. 296.
[24] Ib., p. 300.
[25] Ib., p. 213.
[26] Blake. Ib., May, 1891, p. 403.
[27] Ib., June, 1891, p. 511.

BOTANY.[1]

The Flora of Chicago.[2]—In this clearly printed catalogue the authors have made a valuable addition to the list of local floras of this country. Very properly the catalogue is prefaced by a brief sketch of Prof. H. H. Babcock, who did so much to make known to the world the peculiarities of the vegetation of Chicago and its vicinity. Then follows an interesting chapter on the geology of the region covered by the catalogue. At the close of the chapter the matter is summed up as follows: "Though Cook county, Illinois, and Lake county, Indiana, have neither mountains nor valleys, no frowning cliffs nor rocky glens, they have an interesting geological history, the outcome of which is a very unique botanical area. The rolling prairies, the river bottoms, the sandy ridges, the lake shore, the drift clay and its ravines, the sloughs among the ridges at the south end of the lake, the peat logs which are found in many places, the shallow ponds and sluggish streams, give a great variety of soil for native plants."

In this area there are catalogued 1,140 species and varieties of native plants, 182 of which have been introduced. The largest order is the Compositæ, with 170 species and 19 varieties. The next in order are: Cyperaceæ, 97 species and 19 varieties; Gramineæ, 85 species and 5 varieties. The largest genus is Carex, with 55 species and 15 varieties. The Pteridophytes have 31 representatives. No attempt is made to enumerate the mosses, liverworts, fungi, etc.

The conformation of the nomenclature to modern ideas, and the uniform "decapitalization" of specific names, will commend this catalogue to the majority of the botanists of the country.—Charles E. Bessey.

The Action of Bacteria on the Rapid Souring of Milk During Thunder Storms.—That milk will sour with unusual rapidity during thunder storms is a theory very commonly held among dairymen, and probably is to a certain extent true. It has been stated by various writers that this is due to an oxidation of the milk by the ozone generated in the air at such times, the oxygen of the air being converted into ozone by the electrical discharges.

[1] Edited by Dr. Charles E. Bessey, University of Nebraska, Lincoln.

[2] The Flora of Cook County, Illinois, and a Part of Lake County, Indiana. By William K. Higley and Charles S. Raddin. In the Bulletin of the Chicago Academy of Sciences, Vol. II., No. 1, Chicago, 1891.

This is the conclusion to which two investigators have recently arrived as a result of their experiments.[3] These two, though differing somewhat in methods, arrived at practically the same conclusions,—viz., 1. Ozone will attack milk, and produce lactic acid by a process of direct oxidation; 2. During a thunder storm sufficient ozone is generated by the electrical discharges to exert this oxidizing action on milk.

The method of both these experimenters, in brief, was to expose milk to the action of ozone generated by a spark of electricity passing through oxygen. This was done in a closed vessel, partly filled with milk, and the air above the milk displaced by oxygen; ozone could then be generated by passing a spark across through the oxygen. According to both observers, a spark passed in this way from fifteen to twenty minutes would generate enough ozone to coagulate the milk in less than an hour. According to Prof. Tolomei, this action is even more rapid if, instead of a spark, a "silent discharge" of electricity from the two poles of the battery be employed. This is due simply to the fact that a larger amount of ozone can be generated from a given quantity of oxygen by the "silent discharge" than by a spark.

These results differ considerably from some obtained in this laboratory some time ago. Since the publication of Tolomei's work ours has been repeated, and gives exactly the same results as were obtained before.

Our methods were similar to those described above. A Wolff bottle was taken and filled with milk and oxygen. Wires connected with a Holtz induction machine were then passed in at the opposite necks of the bottle, and ozone generated by passing electricity, either as a spark or in the form of a silent discharge, across through the oxygen. A second bottle was partly filled with milk and kept as a control.

Although repeated over and over, under various conditions of temperature, and with milk of various degrees of sweetness, from that just from the cow to that a day or more old, in no case were we able to produce any such rapid souring as was described by Iles and Tolomei. We did, however, get a slight hastening of the time of souring. If the control coagulated in thirty-six hours, that experimented on would coagulate only an hour or two earlier. Moreover, we found that free oxygen alone was sufficient to produce this slight hastening.

[3] D. W. Iles, *Chemical News*, Vol. 36, p. 237, 1877. Prof. Tolomei, *Biedermann's Centralblatt für Agriculturchemie*, 1890, p. 538.

A further experiment showed that if the milk used be *sterilized* before it is treated with oxygen and ozone, and is then protected from contact with unfiltered air, no coagulation occurs, no matter how much oxygen is introduced. We have subjected sterilized milk to the action of the electric spark for over an hour, and then kept this milk in our laboratory two months, without the appearance of the least sign of coagulation.

From the fact that only a slight hastening of the time of souring resulted in the case of ordinary milk, and that no coagulation at all was produced if the milk were sterilized, we conclude that the process cannot be one of oxidation, but is due rather to the rapid growth of the bacteria of the milk under the influence of the free oxygen, and, possibly, to a certain extent, of the ozone also.

It is possible that during a thunder storm a sufficient amount of ozone may be generated to stimulate the bacteria and bring on a rapid souring. It seems very improbable, however, that the small amount of ozone usually produced at such a time could have any such effect.

The true cause, it seems to us, is to be found in the warm, sultry atmosphere which usually precedes and accompanies these storms. These atmospheric conditions, as is well known, are especially favorable to the growth of bacteria, and this rapid growth brings on a correspondingly rapid souring of the milk.

These are, in brief, the conclusions at which we have arrived from the results of our experiments. They are, to a certain extent, borne out by the experience of the proprietor of a neighboring creamery. He finds that if milk be kept at a uniformly low temperature, no trouble results from souring during the thunder-storm season.

It will be seen from the above that ozone, at least in the small amount (about five per cent.) which can be generated from a given amount of oxygen by the electric spark, is not destructive to the bacteria which causes the souring of milk. This fact is of interest, in view of the common use of ozone as a disinfectant.—AARON L. TREADWELL, *Biological Laboratory, Wesleyan University.*

The Parry Herbarium.—This important collection of plants has been carefully arranged and catalogued, and is now offered for sale by Mrs. E. R. Parry, the widow of Dr. Parry. It is particularly rich in western and southwestern species. The whole number of determined specimens is eighteen thousand, representing 6,780 species. By far the greater portion of the species are North American, but seven hundred being natives of other parts of the world. It is to be

hoped that this herbarium will come into the possession of some institution which will make it accessible to the botanists of the country.

Palmer's Mexican and Arizona Plants of 1890.—The plants collected by Dr. Edward Palmer during the year 1890 have been determined by Mr. J. N. Rose, of the National Herbarium, whose report has just appeared as one of the "Contributions." A good many new species are described, one of the most interesting of which is *Echinopepon cirrhopedunculatus*, a near relative of our familiar *Echinocystis lobata*. In the new species the female flowers are borne upon slender, coiled, tendril-like peduncles, from three to six inches in length. Apparently we have here a hint as to the morphology of the tendrils of the Cucurbitaceæ. This would indicate their cauline nature.

Three Months of Elementary Botany.—By setting the student at work collecting green-slimes, pond-scums, smuts, leaf-spots, toad-stools, lichens, scouring rushes, together with flowering plants, many kinds of vegetable forms are presented to him, and their resemblances or differences readily impress themselves upon his mind. This discursive collecting is not so symmetrical or simple as the ordinary selective method which rejects anything without a flower at least half an inch in diameter. It is calculated however, to give a more just idea of the plant world as a whole. With reference to structure, much more can be seen with the unaided eye than teachers suppose. For example, a thin slice of squash stem held up to the light shows clearly enough the subepidermal tissues and the bicollateral structure of the vascular bundles. A vast amount of dissecting and anatomical work can be done with pins and pocket-knives. If rightly used, the eye is a splendid microscope, but one must use it with the "fine adjustment." Even things which it is fashionable to slight may become productive under proper handling. Phyllotaxy—that much abused and ridiculed section of anatomy and physiology—presents admirable fields of study in the mechanics of development. Close examination of the shoot-epidermis opens up almost every division of physiology. For the epidermal system is specialized for defence, nutrition, growth, irritability, attraction—sometimes—of insects, and, with its color, texture, thickness, extent, perforations, projections, secretions, is a most convenient and instructive object of attention in a three-months' course of botany. In connection with such work in morphology and physiology, the structure of flowers, the physiology of reproduction, the principles of classification may be

studied. The demonstrations—by the developmental chain from the lower to the highest plants—that the pollen plant is itself an independent plant, is instructive.

Let us see what the method of presentation should be in the department of plant physiology. In its modern aspect, this is rather the newest field of botanical investigation. It is commonly supposed to be quite beyond the resources of an ordinary equipment, and is mentally associated with regiments of flasks, brigades of induction-coils, and whole armies of expensive and delicate pieces of apparatus. Certainly all the resources of chemistry, physics, and mechanics may be brought to bear upon the science of botany, and the result is our present mechanical or physico-chemical theory of plant life. But, although one may conduct experiments of great delicacy, it is scarcely imperative, on that account, for the teacher trying to give an evenly balanced six fortnights of botany to present such experiments. The truth is, one may do most of the physiological experiments without apparatus. Seedlings planted in little boxes which may be set on edge illustrate geotropic curvatures; others set in the window illustrate the heliotropic position. To etiolate a plant needs but an empty flower-pot turned over it. Tissue tensions are illustrated by slicing a radish or parsnip and soaking awhile in water. Tendrils may be stimulated to curvature, bladderworts and pitcher-plants may be grown for examination, leaves may be covered with felt pads to illustrate the transitional movements of the chorophyl bodies within; the phenomena of wilting, artificial culture solutions, fermentation, temperature changes in germinated seeds, and a hundred others are demonstrated without difficulty.

For such a course there is no text-book. The teacher must give it by brief lectures, or better, by occasional dictations. Some such compilations as Dr. Goodale's "Physiological Botany," or "Vine's Lectures on Plant Physiology," may be used for reference. Pfeffer and Detmer are the best authors for those who read German, and Frank's little books are admirable. By such a course, brief though it may be, the student will learn that there is not a position of a leaf, not a coil in the tendril, which has not its sufficient cause. Thus he will learn in proper fashion what is meant by scientific investigation.

It may be urged, and not without reason, that such courses as have been briefly outlined are too extended for the time allotted them. Such is not the case, however, for such courses are practical, as is shown by their adoption in more than one college and academy in America. Students should not be persistently underrated. Even

the dull ones will be able to radiate a little light of their own if opportunity is given them to do something more than repeat the feeble beams of a text-book. And this is the greatly needed thing; this is the essential thing,—that students should think for themselves. Original thought is the spirit of the present, the genius of the future. A rational course of study is the alembic which can precipitate such thought from a solution of confused and half-formed notions. Science itself is to be defined as that mass of facts within experience by which we criticize our primitive ideas. Therefore, everything should be bent to bringing forth true thought from the pupil; otherwise he cannot arrive at intellectual manhood.—CONWAY MCMILLAN, *in Education.*

ZOOLOGY.

The Anatomy of Phagocata.—Woodworth's paper [1] on the structure of this Triclad is a valuable contribution to our knowledge of the Turbellaria. This worm, described by Leidy forty years ago, has been neglected until now. Woodworth has investigated the anatomy in a thorough manner, and besides confirming Leidy's account of the many pharynges—doubted by several helminthologists—has investigated all parts of the animal. Phagocata possesses a main pharynx which opens at the junction of the three branches of the alimentary tract, and, besides, many others which open into the posterior trunks of the intestine. These are arranged without apparent order, except that the further they are from the median pharynx the smaller they become. The development of the rhabdites is traced. They arise in gland cells lying in the mesenchyme, and pass up into the hypodermis, where they have an intercellular position, by means of tubular projections of the mother cells. Woodworth thinks the function of the rhabdites to be to aid in the capture of prey, since by their slow solution in water they form a thick mucus. The body of the animal is usually darkly pigmented, the pigment being scattered granules intercellular in position. In its nervous system Phagocata stands intermediate between Gunda and Rhynchodesmus. There is a superficial and a deeper portion, the two being indirectly connected by means of a marginal nerve. The vasa efferentia are products of the testes; and the growth of the yolk glands

[1] Bull. Mus. Comp. Zool., XXI., No. 1, 1891.

shows that these and the ovaria are formed by differentiation from a common anlage. The pseudocœle spaces in the parenchyma are intercellular.

Crustacea and Echinoderms of Japan.—Mr. J. E. Ives has recently studied[2] the collections made by Mr. Frederick Stearns in Japan. The novelties described are: *Pectinura stearnsii*, *Cryptodromia stearnsii*, and *Ascorhyncleus japonicus*.

The Affinities of the Molluscs.—Thiele has done some good word in the anatomy of the Mollusca, and hence his recent paper[3] is a surprise. Thiele not only considers the phylogenetic relationship of the molluscs, but of most of the invertebrates as well. Space is available but for a few samples of his conclusions. The lowest Ctenophores stand lower than all other Cœlenterates and nearest to the primitive metazoan. From them with "kaüm ein Zweifel," the sponges "ohne Schwierigkeit" are to be derived, the apical pores of the Ctenophore giving rise to the pores of the sponge! So, too, from them come the Cnidaria and the bilateral animals. In the group of molluscs, derived from the Plathelminthes, some peculiar "homologies" are recognized. Thus the operculum of many Gasteropods is the homologue of the posterior element of the chiton shell. The Trochophore is homologized, bit by bit, with the Ctenophore, etc., etc. The whole is supported by an idea of "centralization" which, in its application, is carried to the same extreme as was a few years ago the principle of "cephalization" advanced by an American author, and which receives its deathblow in the same group (the Crustacea) in which it was supposed to receive its strongest confirmation.

The Head of Elasmobranchs.—Miss Julia B. Platt continues[4] her studies of the vertebrate head, to which reference has already been made in our pages. She shows that in Acanthias the alimentary canal at first extends forward beyond the neural plate to the anterior extremity of the embryo, and later the anterior portion of the entoderm is separated from the rest by the downward growth of the infundibulum. There is evidence which goes to show that the notochord formerly extended to the anterior end of the entoderm. From the anterior entoderm arise the anterior head-cavities, and a second pair of cavities in front of the mouth are formed by cells proliferated from the dorsal ento-

[2] Proc. Acad. Nat. Sci. Philadelphia, 1891, p. 210.

[3] *Jenaische Zeitschrift*, XXV., p. 480, 1891.

[4] *Anatom. Anzeiger*, VI., p. 251, 1891.

derm. These cavities have at early stages a nerve supply in which both motor and sensory roots occur; one nerve, called the "thalamicus," being apparently a new discovery, and is probably to be regarded as the dorsal root of the oculomotorius.

The Reproduction of the Conger.—Mr. T. J. Cunningham thinks[5] that the conger eel reproduces but once in a lifetime, and then dies. He gives many facts, new and collected, to support this view, although he has never obtained ripe eggs. The female increases in size towards the period of maturity, and this growth, sometimes so excessive as to burst the body open, is the result of the enlargement of the ovaries. During some months before maturity both male and female congers refuse all food, and all reserves stored up in the body are transferred to the reproductive organs. This process goes so far that the teeth are lost, while the bones of the skull lose all osseous characters and cut like cheese. From various facts Cunningham reasons that the eggs of the conger are pelagic and transparent, and he attempts to identify certain unknown eggs from Naples with several Muraenoid fishes.

A New Species of Frog from New Jersey.—It is well known that the coastal plain of New Jersey is both zoologically and botanically very different from the Piedmont regions, and that its species have a greater or less distribution in the corresponding region of the states to the southwest of it. Among fishes, the few species of the Percid genera Acantharchus and Enneacanthus range through the entire coastal region, with the *Etheostoma barrattii.* The *Mesogonistius chætodon* covers so far, only New Jersey and the Chesapeake peninsula, while the *Lepomis phenax* has not yet been found south of New Jersey. Among Batrachia a marked instance of this distribution is furnished by the *Hyla andersonii,* which has been found at two localities in New Jersey and one in South Carolina. I have now to add to this list a species of Rana found in Southern New Jersey, which has hitherto escaped detection. It is a most distinct one, and about the size of the wood frog (*Rana silvatica*).

Rana virgatipes, sp. nov.—Vomerine tooth patches between the choanæ, and extending posteriorly to their posterior border. Hind legs short, the heel extending from the middle of the tympanum in some to near the eye in other specimens. Webs rather short, two phalanges of the fourth toe free. Præhallux small, but quite promi-

[5] Jour. Marine Biol. Assn. United Kingdom, II., p. 16, 1891.

nent; no external solar tubercle. Skin of upper surfaces of body and posterior limb covered with minute tubercles; no longitudinal dermal folds. Males with, females without, external vocal vesicles. Interocular width one-half that of each eyelid. Tympanic disk distinct, equaling the eye in longest diameter. Head (to posterior border of tympanic disk) about one-third length of head and body. End of muzzle oval-acuminate, projecting moderately beyond mouth border. Nostril opening vertically equidistant between border of orbit and end of muzzle. First and second fingers subequal and longer than the fourth.

The color of the upper surfaces is an olive-brown, varying to more or less yellowish or blackish. Two light-brown longitudinal bands on each side, one commencing at the orbit and extending above the tympanum to the sacrum or beyond it; the other commencing at the muzzle, involving the upper lip, and extending to the groin. The dark color of the top of the muzzle contrasts strongly with the lighter color of the upper lip, at the canthus rostralis. The inferior band is bounded below from the axilla to the groin by a wide black band, which is made up of several more or less confluent spots. Inferior surface of head and body white; the former dusted with blackish in both sexes, the latter with or without blackish blotches. Fore limbs brown above, black on anterior and posterior faces, and white, with blackish blotches, below. Hind limbs brown on upper surfaces, with two or three black blotches on the femur and tibia. Remainder of hind limb and foot black, with the following exceptions: A light-yellow band commences at the groin and extends along the femur, passing under the knee to and along the external border of the tibia and the anterior face of the foot. It expands here, and extends on the anterior surfaces of the first, second, and third digits. A subtriangular white blotch occupies the middle of the inferior surface of each femur, meets its fellow, and sometimes connects with the white of the belly on the middle line. A narrow, horizontal white line, generally broken into spots, divides the black of the posterior face of the femur. Inner edge of tibia with some white spots.

Length of head and body, 60 mm.; width of head at posterior borders of tympana, 21.5 mm.; length of fore limb from axilla, 28 mm.; length of hind limb from vent, 76 mm.; length of hind foot, 39 mm.; of tarsus, 15 mm.; of tibia, 23 mm.

This frog is not nearly related to any species of the genus. It has some points of resemblance to the *R. temporaria*, as the short posterior legs and moderate web; but the interocular space is much narrower,

the vomerine teeth more anteriorly placed, and there are no dermal folds. In coloration there is no resemblance to any other species.

I obtained five adult and two half-grown individuals, and had two other adults almost within my grasp, but they escaped me. The specimens agree nearly in size, the chief differences being observed in the amount of dark blotching of the belly and the regularity of the markings on the inferior side of the femur. The specimens were found in a cut-off of a tributary of the Great Egg Harbor, River in Atlantic county, New Jersey. The water is stagnant, and is well grown with Nymphæas, Utricularia, and Sphagnum. The frogs did not display any considerable powers of leaping or swimming, but concealed themselves with much ease within the aquatic vegetation. I did not observe any voice. In the same locality I observed the *Ranæ virescens* and *clamata*. The cut-off is in the woods, and I found no individuals in similar situations in the open country, nor any along running water in the woods.

The oversight of this conspicuous species is a curious circumstance. —E. D. Cope.

Zoological Notes.—General. — Dr. A. Voeltzkow has been giving [6] a general résumé of fresh-water fauna of Madagascar. The present paper gives promise of many interesting facts when the completed paper appears, both of new forms and of geographical relationships.——Frenzel describes,[7] without naming, an interesting infusore from a salt-water aquarium in Argentina. It is saccular, pointed at either end, and depressed so that it may be called bilateral, the ventral surface being flattened, the back rounded. The lower surface is ciliated, the dorsal with a few short bristles. In front is a mouth, posteriorly an anus, the mouth being surrounded by strong cirri. The wall of this organism is composed of a single layer of cubical cells, bounding the "alimentary canal." Reproduction takes place in two ways: (1) by transverse fission, and (2) by conjugation and subsequent encystment. Two individuals oppose the ventral surfaces, and contract into a sphere which secretes a cyst. The internal processes were not clearly observed; it appears that the alimentary lumen is filled by cell division, so that the whole cyst is filled with similar cells, each of which is to be regarded as a spore which, after liberation, swims about as a ciliate, and by cell division develops directly into the adult. No hints are given as to the relationships of this form.——Mr. F. A. Lucas describes [8]

[6] *Zool. Anzeiger*, XIV., 1891.

[7] *Zool. Anz.*, XIV., p. 230, 1891.

[8] Proc. U. S. Nat. Mus., XIV., p. 169, 1891.

several points in the structure of the humming-bird's tongue. This organ is tubular, but as it lacks any pumping apparatus it can take fluids only by capillary attraction. Lucas thinks it is rather an instrument for the capture of small insects, a view supported by the size of the salivary glands.——*Tetraprion jordani* is the name of a new tree toad from Ecuador described[9] by Dr. L. Stejneger and Mr. F. C. Test. It differs from all other Hylidæ in the presence of palatine teeth.——A recent paper by Barton A. Bean[10] on the fishes of the Chesapeake is interesting from its richness in local names. Thus, the file-fish is locally called fool-fish; the flounder (*Paralichthys dentatus*) is the chicken halibut; the toad-fish, bull-fish; *Stromateus paru*, butter-fish; the weakfish as trout or gray trout; scup is maiden; the sea-bass is black will or black nell; the blue-fish is tailor; the menhaden is old wife, etc.

EMBRYOLOGY.[1]

Embryology of the Sea Bass.—Dr. H. V. Wilson has published in the bulletin of the United States Fish Commission for 1889, Vol. IX., a contribution to the embryolgy of *Serranus atrarius* in particular, and teleostean embryology in general. The paper covers sixty-eight pages of text, and is accompanied by twenty photo-lithographic plates. Dr. Wilson has given a most excellent account of the development of a single fish, from the egg to the time when the young fish hatches. To those desiring a simple and straightforward account of fish development, brought up to date, the present contribution will meet every want. As a contribution of original research the different parts are of different values. For instance, while the sections on gastrulation, concrescence, and the formation of the lateral line are valuable, and largely, more especially the last, original contributions to modern embryology, yet the sections dealing with the central nervous system, blood vessels, notochord, gill-slits, anterior body-cavities, etc., are by no means so fully treated, and little addition is made to our present knowledge. This, perhaps, is a necessity of the attempt to cover so large and so well worked a field; indeed, one of the most prominent facts brought out in the paper is that the grounds seem so

[9] Proc. U. S. Nat. Mus., XIV., p. 167, 1891.

[10] Proc. U. S. Nat. Mus., XIV., p. 83, 1891.

[1] Edited by Dr. T. H. Morgan, Johns Hopkins University, Baltimore.

thoroughly to have been covered by previous writers, and the author attempts to show in the fairest manner possible which of the (always) several accounts is the more probable from his "observations on the bass." We may now pass critically over the different sections of the paper.

The egg of the sea bass is a small pelagic egg, about one mm. in diameter. Imbedded in the yolk, but near the surface, is a single large oil globule, which is always uppermost in the floating egg. After fertilization the protoplasm, which heretofore formed a thin layer over the egg, begins to flow to the pole opposite to the oil globule (lower). This patch of protoplasm at the lower pole is at first circular. Just before or during the first act of cleavage there arises an inequality in the axes, so that by the time the first two blastomeres are marked off the germ is bilateral. In the bass and mackerel the first two blastomeres are of equal size. "This is normally so with the cod as well; but on one occasion I observed that in all the eggs got from a single codfish the first two blastomeres were unequal in size. The inequality was very marked; but the eggs were healthy and the average percentage of fish was hatched out."

This observation, which the author does not further follow up, must have an important bearing on the relationship of the first cleavage furrow to the plane of the adult body, and hence on the problem of the quantitative relationships of protoplasm (and nucleus?) in cell division. The somewhat hasty generalization, that in the Triploblastica the first cleavage plane divided the egg into right and left halves with reference to the adult, is meeting with general and inexplicable exceptions; and it is the exceptions determined by casual observation as the above that show clearly that we do not yet understand the relationship between egg cleavage and adult structures.

"The teleostean segmentation [cleavage of the egg] has undoubtedly been derived from a total segmentation essentially like that of Amphibia; and convinced of this, Rauber, Agassiz and Whitman, and Ziegler have endeavored to homologize the early furrows in the two groups. In regard to the first two furrows there can no be difference of opinion. The homology of the third teleostean furrow is by no means so clear. Ziegler, without entering into a detailed discussion of the matter, regards the first three furrows in the two groups as homologous. Agassiz and Whitman, after a critical examination of Rauber's views, also pronounce in favor of this homology, deciding that the third teleostean furrow represents the equatorial furrow of Amphibia. I do not find, however, their reasons sufficient for discarding the homology offered by Rauber, supported as it is by variations (atavistic) in the teleostean germ toward

the amphibian segmentation which so exactly imitate the teleostean types. . . . . According to Rauber, the first equatorial furrow of the frog has been lost in the Teleost. Agassiz and Whitman would seem to believe that the *a priori* improbability of such a loss taking place is so great that, in spite of the variations just described, it is preferable to regard the first three furrows as homologous in the two groups. I do not see the inherent improbability of the loss. On the contrary, the disappearance of segmentation in the ventral half of the egg, coupled with the early contraction of the protoplasm (belonging to this half) towards the upper pole, make it easy, I think, to understand how the loss was brought about." The author seems to have come to this conclusion largely on account of the close resemblance in the arrangement of the eight micromeres in the 16-celled frog's egg with the eight-celled stage in the bass; but inasmuch as there exist the greatest individual differences in the arrangement of the micromeres in the frog, and also in the fish, we have every reason to believe such a general resemblance might have been independently acquired in each case, and that the eight-celled stage in the fish corresponds to the 16-celled stage in the frog; and that the resemblance between the 16-celled stage (eight micromeres, eight macromeres) in the frog and the eight-celled in the fish is entirely superficial. Moreover, if, as the author attempts to show, the fish gastrula may by derived directly from the frog's gastrula, we have every reason to believe that so fundamental a process as the cleavage stages must be similar, making a very strong "*a priori* improbability" that the third furrow of the frog has dropped out of the fish egg.

As is well known, the eight-celled stage of the frog separates in general the micromere cells of the upper (anterior?) pole from the lower cells containing more yolk. Now if the view taken by Agassiz and Whitman be true, it would seem probable that in the eight-celled stage of the fish four (most probably the more central four) cells would be entirely cut off from the protoplasm covering the yolk, and that the other four cells would have their protoplasm continuous, in part at least, with the protoplasm covering the yolk. To some extent the author's figures bear out such an interpretation, although he does not seem to have examined the sections from such a point of view.

The origin of the periblast in the bass is the same as is described in Ctenolabrus by Agassiz and Whitman. "These authors proved beyond a doubt that in Ctenolabrus the nuclei are derived from the marginal cells of the blastodisc, which from the earliest stages of segmentation are connected with the yolk or periblastic protoplasm." (See above.)

The whole of the periphery of the blastoderm turns in, forming a layer between the periblast and the superficial ectoderm of the animal pole. The invaginated layer from the posterior pole gives rise to the mesoblast and notochord by delamination, and the remaining cells go to form the midgut, the periblast taking no part whatever in the latter structure, but remaining encircling the yolk, and ultimately assisting to digest it when it begins to disappear by absorption by the liver cells. The blastodermic cap grows over the yolk. "As the blastopore grows smaller, the extra embryonic part of the germ-ring is *pari passu* drawn into the tail end of the embryo, and there is thus built up in this region a constantly increasing wall of undifferentiated cells. . . . In the bass there is no actual concrescence in the middle line; but the terminal notch observed in some fish, as well as the general considerations derived from a comparison of Teleost with Amphibia, warrant us in regarding the closure of the blastopore as a process of concrescence, the result of which is to establish the primitive streak. The entire mass of undifferentiated cells left at the tail of the embryo after the blastopore closes serves as a cellular material for the backward growth of the several organs. Thus, while the extra embryonic germ-ring, as has been insisted upon by Agassiz and Whitman, and Cunningham, assuredly forms part of the embryo, it does not form any special part; but, on the contrary, its cells eventually find their way into ectodermic, mesodermic, and notochordal tissues" of the tail. In other words, the author believes the two halves of the trunk of the embryo are not formed by concrescence of the blastopore, mesoderm, or any modification of it, but that all of the mesoderm turned in around the rim (except at the post-embryonic pole) accumulates at the upper ridge of the blastopore (in the caudal mass) and at its sides, and this latter differentiates into the mesoderm and its products in the tail.

"The alimentary canal is formed from the simple endoderm lamella [invaginated endoderm without the parablast] by a process of folding along the median line. The fold is converted into a tube by the meeting of its lower edges. There is a solid postanal gut formed as a thickening of the endoderm lamella. not as a fold. At the end of the postanal gut is Kupffer's vesicle, which is formed in essentially the same way as the permanent alimentary tube. It is scarcely necessary to say that Kupffer's vesicle and the entire post-anal gut [subsequently] atrophy." "The discovery of this vesicle was made by Kupffer in

1868, and since then it has occupied a conspicuous place in the embryology of Teleosts. . . . The alimentary canal is formed by a process of folding, and Kupffer's vescicle, as the terminal part of the postanal gut, follows the same method. After the gut has once been folded off, the homology of the vesicle with the postanal vesicle of Selachians is obvious. In each group the vesicle forms the dilated extremity of the postanal gut, and receives, or would receive if it existed, the neurenteric canal. . . . But if Kupffer's vesicle in its early stages indicates that the terminal portion of the archenteron was primitively dilated, we naturally inquire both for the causes and for a corresponding phenomenon in the ontogeny of those ainmals in which the archenteron is bodily transformed into the permanent gut. As to the latter point it would seem very common in the Amphibia for the archenteron to be thus dilated. The existence of such a dilatation in the enteron of the primitive Chordata is further made probable by, and receives an explanation from, the relation of the neurenteric canal to the blastopore. It will be seen that in the interpretation of Kupffer's vesicle I substantially agree with Cunningham: it is the terminal part of the archenteron."

The most interesting addition to our knowledge is the author's discovery that the ear, branchial sense-organs, and organs of the lateral line arise from a common structure or embryonic "anlage." "It has been noticed in the trout that the anlage which was supposed to develop into the ear is remarkably long. I have found that this anlage not only gives rise to the ear, but to a functional branchial sense-organ and to the organs of the lateral line as well. Before the blastopore closes there is found behind the eye a long, shallow furrow [the sensory furrow] in the nervous layer of the ectoderm. At two points the furrow begins to deepen, the deepening taking place downwards and inwards. At these two points the auditory sac and the branchial sense-organs will respectively be formed. . . . A further stage in the development shows that the deepening of the furrow in the auditory and branchial sense-organ regions has continued until there are are two well-marked sacs, the anterior of which is the branchial sense-organ, the posterior the auditory sac. Between the two sacs persists the connecting portion of the sensory furrow, and behind the auditory sacs the furrow is continued for some distance. *The posterior portion of the furrow constitutes the anlage of the lateral line.*

"The homology instituted by Eisig between the lateral line organs of fishes and the 'seiten organ' of certain Annelids is well known. Balfour, in his text-book, declined to accept it; and though Beard

favored the homology in his paper on the teleostean lateral line, after studying the Selachians he gave it up. Now that the early development of the lateral line is approximately known in Teleosts and Selachians, there seems less than ever to be said for the homology. If it could be shown that the segmental sense-organs of Annelids, leeches, etc., arise from an anterior anlage, which grows and, so to speak, distributes the sense-organs along the trunk, the homology might well be supported. But as far as I know the invertebrate segmental organs arise *in situ*."

"The fact that there is in the bass a common anlage for the ear, branchial sense-organ, and lateral line has certainly no phylogenetic significance. It can only be regarded as a convenient method of forming these sense-organs which the embryos of certain animals have adopted. It, however, serves to emphasize in a striking way the serial homology between the organs which previous work has already made so probable." The interpretation of this latter quotation is somewhat obscure and the author's meaning difficult to read betweeen the lines. If he means that the ear, branchial sense-organs, and lateral line have arisen in the adult in the same position found in the adult to-day, and have subsequently concentrated in the embryo into a single anlage, he brings no evidence forward to support his position. If he means that in the adult these three sets of organs arose from a single anterior organ, and the ontogenetic phases repeat the ancestral process, then the theory seems in better accord with the facts, but his words seem to bear out no such interpretation. At any rate, to announce that in their origin, which he has himself discovered, there is no "phylogenetic significance" seems an extremely hazardous affirmation. In any case, however, the discovery itself is extremely important, and may have an important bearing upon the question of metamerization of the vertebrate as contrasted with that of the Annelid.

The last section deals with "General Morphological Questions," touching mainly upon concrescence and the interpretation of the process of gastrulation in the Teleost. "In the growth of the blastoderm around the yolk, the head end of the embryo does not remain a fixed point, as His supposed. On the contrary, the tail end of the embryo (posterior pole of the blastoderm) remains a comparatively fixed point, as Oellacher first showed, while the anterior pole of the blastoderm travels rapidly around the yolk. The point where the blastopore closes is thus but a short distance from the original position occupied by the posterior pole of the blastoderm. Owing to the constant position of the single oil globule, these facts can easily be

made out." This argument itself is vitiated in the assumption of a fixed point for the oil globule, as the author gives little reason for believing that the latter may not change position with the growth of the embryo. Moreover, and this is much more important, the author's conception as to the position of the frog's gastrula in relation to the poles of the embryo may not be correct, and must seriously alter his conception of the position of the fish embryo to the egg if he insists on a strict comparison of the two forms. (See below.)

The author's conception of gastrulation in the fish may be gathered from the following quotation: "Accepting Ziegler's homologies, it will be seen that the whole course of the fish development becomes easy to understand. Starting with the blastula, and disregarding for the present the non-embryonic part of the germ-ring, the primitive hypoblast corresponds to the primitive hypoblast which invaginates around the dorsal lip of the blastopore in the frog gastrula. The chief point of difference is the lack of continuity in the fish embryo between the inner edge of the invaginated layer, and the yolk is easily explained as an adaptation to the method of forming the alimentary canal from the invaginated layer exclusively. The archenteron lies between the primitive hypoblast and the periblast. In consequence of the absence of continuity between the yolk and the invaginated layer, the archenteron at its edge is not separated from the segmentation cavity *The growth of the anterior pole of the blastoderm around the yolk represents the growth of small cells around the yolk-cells in amphibian gastrulation.* The closure of the blastopore takes place in the same way as in the Amphibia; there is formed a short primitive streak behind the position of the neurenteric canal (Kupffer's vesicle in Teleosts); at the posterior end of the primitive streak the final closure takes place. . . . The asymmetry which Balfour showed to be a characteristic attribute of vertebrate gastrulation is present in the highest degree in the Teleost gastrula. At the posterior pole of the blastoderm (dorsal lip of blastopore) there is an extensive invagination which gives rise to the roof of the archenteron. The cause of the asymmetry must be looked for in the peculiarly localized distribution of the yolk in the egg."

The italics above are my own, and emphasize the fact that the author does not realize that in the gastrulation of the Amphibia, to which he, so constantly refers, the anterior pole does not grow over the yolk in an epibolic fashion, but that the anterior (black) extension of the blastoderm over the yolk takes place by a delamination of ectoderm cells from the large yolk-containing cells (see AM. NAT., Embryology, August, 1891). This latter view has been recognized by Kupffer and

Hertwig. "Now the growth of the blastoderm over the yolk does not take place, according to Kupffer, in a true epibolic fashion, but is accomplished through the medium of a zone of tissue in which the yolk-cells become transformed into the cells of the two primary layers. Hertwig holds the same opinion. If this be really the case in Amniota, two explanations of the process are possible: First, that it is a modification of the ancestral, epibolic growth, such as occurs in Teleosts, which view Kupffer and Hertwig would of course reject, because it is equivalent to admitting the homology of the blastoderm edge in Teleosts and Amniotes, and consequently the correctness of the Balfour-Rauber hypothesis; secondly, that the process is, to refer it to simple embryonic forms, one of progressive delamination. It will be seen that Kupffer's hypothesis really implies the occurrence of the latter process, for when he explains the spreading of the blastoderm as the completion of the blastula stage he really means that the embryo splits off ectoderm progressively from a to a^1 towards m (anterior embryonic portion). Thus, again, to refer the processes to their simplest forms, over one half of the blastula (yolk half) delamination occurs; but in the other half there is a true invagination (region of prostomia and primitive streak). . . . However, the analysis I have given is, I think, a perfectly fair one, and the result is evidently prejudicial to their theory. For the conclusion is that the Amniotic vertebrates have a blastula which invaginates over one half and delaminates over the other. Such an embryonic form is nowhere known to occur, and the theory which is forced to assume its existence is in so far a weak theory, and must give place to any other which can explain the facts by making use only of known processes." Unfortunately for the author, the weak theory is probably to be regarded as a real fact, and if so the author's argument collapses. Whether or not a readjustment of the author's views may show him to be largely in the right, is another question for the future to settle. Meanwhile any conception of fish (and Amniote) gastrulation must take into account as a starting point the delamination over the anterior and ventral face of the early stages of the frog's development.—T. H. M., *September 9th, 1891.*

The Development of Hydra.[2]—The ground already covered by Kleinenberg ('72), Kerscher ('89), and Korotneff ('83) has again been worked over by Dr. August Brauer. The following species of brown ("not green") hydras were studied: *H. grisea.* Eggs and

[2] *Zeit. Wissen. Zool.*, Bd. 51, Heft. 2, 1891.

spermatozoa. May, June, and July. Bisexual. The eggs fall off from the mother as soon as the outer coat of the embryo is formed. The embryos do not hatch for one or two months. *H. fusca.* Eggs mature in October. Bisexual. The eggs do not fall off, but are stuck to surrounding objects by means of a jelly, and flatten down somewhat on the support. Probably the eggs are deposited in different places. The time between egg-laying and hatching is as in the last species. *H. sp. ?* Adult resembles closely *H. fusca.* More than half of the individuals kept in the aquarium developed into males alone, and later after the disappearance of the testes they did not develop eggs, but continued to bud. The remaining individuals developed into females. The eggs remain attached to the mother. When all of the eggs have developed as far as the two-layered stage the mother contracts strongly her body down to the base. The eggs come to lie around the base of the mother, remaining sticking to her. The mother remains in this strongly contracted condition for several weeks, and the embryos often escape from the shell before the parent again extrudes. Three embryos hatched in one case fourteen days after the contraction had taken place.

The author suggests that the adult species may be identified in the form of the eggs and the structure of the egg-case :

1. *Hydra viridis.* Egg falls off. Form spherical. Case smooth.

2. *Hydra grisea.* Eggs fall off. Form spherical. Case covered with large and often branched spines.

3. *Hydra fusca.* Eggs singly stuck to objects. Form below, flat ; above, convex. Case covered with spines only on the upper surface.

4. *Hydra sp. ?* Eggs (at base of mother) generally all stuck at one place. Form spherical. Case covered with short spines.

The maturation and fertilization of the egg is described in much greater detail than ever before. The egg begins to round up, drawing in the protoplasmic processes, but still remaining beneath the ectoderm. At this stage the *two* polar bodies are extruded. The egg later breaks through the overlying ectoderm, but remains attached by a broad base. Fertilization then takes place.

The eccentric position of the segmentation nucleus causes the first furrow to begin at the distal pole (away from the mother), and then, after many changes in the outline of the egg, the yolk follows the nuclear division, and moreover, *in the same way as Bergh*[3] *describes in Gonothyræa,—viz., the nucleus divides a second time, and the second*

[3] *Morph. Jahrbuch*, Vol. V., 1879.

furrow is visible while the first furrow has not finished.[4] With the passing of the furrows through the egg the nuclei pass to the middle. If they have reached this after the end of the second cleavage, then the segmentation proceeds more rapidly and regularly.

A blastula stage follows, and from it the endoderm is formed at all points over the surface, by both delamination (Theilung) and migration (Einwanderung). Later the blastula cavity is filled with solid endoderm. From the ectoderm the outer chitinous case is secreted, and later the inner germ-membrane. The ectoderm remains intact, and goes over into that of the adult. The sequence of the appearance of the tentacles does not follow any defined law. The mouth-pole is in all probability identical with the pole that gave rise to the polar bodies.

Morphology of the Vertebrate Head.[5]—In the *Anatomischer Anzeiger* (VI. Jahr., '91) Julia B. Platt publishes a contribution of the " work presented last October for publication in the *Journal of Morphology.*" The present paper deals with the origin of the head segments and their nerve supply. " The anterior limit of the fusion of the edges of the neural plate is therefore not the neuropore, but the anlage of the optic stalk. . . . The optic nerve which later develops into the optic stalk is therefore primarily a dorsal structure, and morphologically the first or most anterior of the cranial nerves. Anterior to the first gill-cleft, Acanthias has therefore seven pairs of somites,—three for the hyoid arch, two for the mandibular, one premandibular, and one ' anterior.' "

In the Teleost Batrachus the author says: " My study of the development of the mouth in Batrachus but confirms the work published many years ago by Dohrn on the development and significance of the teleostean mouth. At an early stage a pair of pockets from the alimentary canal open to the exterior anterior to the hyomandibular clefts. Much later in the development of the embryo the mouth ***breaks through in the ventral region*** of these pockets as a bilateral involution of the ectoderm, fusing with the endoderm, and opening to each side of a central partition sometimes before the median line is

[4] The italics above are my own. The relation between the cleavage of the protoplasm and the division of the nucleus is a parallel case to that observed by Mayer in Pagurus and by E. B. Wilson in Renilla, and are most suggestive facts as to the relation existing between nucleus and cell-body, and while not proving that protoplasmic phenomena may take place independently of the nucleus, yet show that the nucleus does not dominate all cytogenic phenomena.—T. H. M.

[5] ***Anatomischer Anzeiger***, VI. Jahr., Nos. 9 and 10, 1891.

crossed. The little fish is at this stage so large that the double nature of the mouth involution may be seen without aid of a lens. The author is not committed as to whether the breaking through of the ventral region represents a pair of gill-clefts,—*i.e.*, as to whether the Teleost (and vertebrate) mouth arises, as Dohrn supposed, from a ventral fusion of a pair of fused gill-clefts.

Triple Fertilization in Egg of Domestic Fowl.—The infrequency with which triple fertilization takes place in the same ovum, in birds or mammals, is in itself reason for presenting to the scientific student what appears to be a unique specimen illustrating this phenomenon, and upon which may also rest the basis of certain biological speculations. In view of this I have drawn the specimen (see Plate XXII.), shown for the first time, representing topographical features rather than histological detail.

The literature at my disposal and such inquiries as it was possible for the writer to make from reliable sources failed to recall another recorded instance of triple fertilization occurring in domestic fowl. It is in this connection interesting to note that Hertwig, Fol, Pluger, and other observers of note are unanimous in the conclusion that "polyspermy," or more than one spermatazoa entering the ovum, is extremely rare, and, as a matter of fact, generally impossible; and where it does occur in rare conditions, it indicates a pathological condition of the egg-cell, giving rise to the production of abnormalities.

Here we have, in all probability, the entrance of three sperms into the ovum,—a condition indeed so rare as to excite more than ordinary interest in the mind of the naturalist.

I am indebted to Dr. J. C. Millman, formerly in the biological laboratory of the University of Wisconsin, for the generous spirit with which he brought to my notice and allowed me the pleasure of laying the specimen before the reader.—Dr. Joseph L. Hancock, *Chicago, September 29th, 1891.*

PLATE XXII.

TRIPLE FERTILIZATION IN EGG OF DOMESTIC FOWL.

(About thirty-eight hours old.)

ARCHEOLOGY AND ETHNOLOGY.[1]

The International Congress of Anthropology and Prehistoric Archeology of Paris, 1889.—(*Continued from page 844.*) —SEANCE LIBRE.—*Questions—First Question:* "The Existence of Man During the Tertiary Period."

M. Boule presented a photograph of the under jaw of the *Dryopithecus fontani*, found in the Miocene of Saint-Gaudens, Haute Garonne.

M. Delgado, at the head of the Museum of Archeology at Lisbon, presented a collection of flints gathered at Otta, Portugal; thirty came from the Tertiary sandstone and twenty-four came from the surface, and the discussion turned to the existence of man during the Tertiary epoch. He contended that those from the deposit at Otta were really and truly Tertiary, but that the pieces of flint from the surface correspond to those which had been found at Otta by Ribeiro, and, consequently, they were not those which came from the Tertiary.

M. Gabriel de Mortillet praised the method of searching which M. Delgado had pursued. The fact that M. Delgado had once been unable to find the worked flints in the Tertiary deposit proved nothing to his mind, for these worked silex were comparatively rare. There had never been many of them found, and the series such as presented by M. Delgado of twenty-four were about as much any one had been able to find. In the richest deposits of the Quaternary period one can search for days and days and cubic meter after cubic meter of the gravels without finding a single instrument therein, and yet this work, if continued long enough and extended over sufficient territory, as is done in the railroad and canal cuttings at Chelles and at Saint-Acheul, demonstrated the fact that they are in existence in these deposits by the hundreds and even by the thousands.

A lengthy discussion ensued over the methods employed by prehistoric man in the working of silex, illustrated by drawings by M. A. de Mortillet, criticised by others, showing the cracking of flint by the heat of the sun, exposure to the air, by fire, by percussion, and by pressure. M. Docteur Capitan presented a full series of the implements used, and gave a practical demonstration of the methods employed. He had the percuteur or hammer with and without the intervention of a punch, which might be by stroke, direct or indirect, as the anvil, the nucleus, the flake. The primary work was done usually

[1] Edited by Dr. Thomas Wilson, Smithsonian Institution, Washington, D. C.

by percussion, but some of the small and fine flakes, such as those of obsidian made by the Mexicans, were possibly made by pressure.

A flake, larger or smaller, once obtained, was subjected to secondary work by which it was made into the arrow or spear-head, knife or hatchet, according to the intention of the maker and the possibilities of the material. This was done by secondary chipping,—that is, chipping the flake, called in French retouching: 1, by percussion; 2, on the anvil; 3, by pressure; 4, by hammering or pecking; 5, by grinding or polishing. For the pressure a bone implement from paleolithic Grotte de l'Eglise, evidently much used, belonging to the collection of Dr. Capitan, was exhibited.

Which and how many of these methods were employed can only be determined from an inspection of the specimen, the condition in which it was found, and the objects associated with it. From these elements were to be resolved the question as to the man who made the implement and the age or epoch to which he belonged. All but the last two methods were employed alike during both the paleolithic and neolithic periods, while the last two were peculiar to the neolithic.

M. Gabriel de Mortillet, and at the end Belucci and Vilanova, all sustained the proposition that there were proofs of the existence of man during the Tertiary epoch. This was combated by M. Cartailhac, Boule, and Rames.

Monsieur Macedo put up the question of the discoveries of prehistoric human remains at Castenedolo, in Lombardy, Italy, which provoked a discussion by MM. Topinard, de Mortillet, and Cartailhac. Reports in the *Anthropologist*, that the largest investigations made by M. Arturo Issel, of Genoa, adopting the opinion of the geologist, Stoppani, confirms him in the opinion that neither the ancient nor the new skeletons or cemetery at Castenedolo belonged to the Tertiary man.

Second Question:—"The Mines and Workshops of Flint."

M. de Baron de Loë read, on behalf of himself and M. de Munck, a notice upon the excavations recently made in the neolithic *atelier*, or workshop at Spiennes, near Mons, Hainault, Belgium. This memoir added a number of interesting things to those which had already been recorded by MM. Cornet, Briart, and Houzeau de Lehaye at the meeting of this Congress in 1879 in Brussels. The result of the investigation of MM. Loë and de Munck into these wells or shafts of the mines of flint in Spiennes showed that being brought on the surface the flint was wrought in special workshops in the neigh-

borhood, which were without necessary connection with the mine, and shown by slight depressions full of broken and incomplete pieces and chips and flakes, the débris of the shop. Worked objects of deer horn and bone were found, and the pottery was fine and well modeled. The workshops may have been huts occupied as habitations, more or less temporary, by the workmen. They were probably made of some light material, of which the traces are still found on the surface. The special characteristics of the objects found in these workshops showed that there had been a division of labor, and that each workman confined himself largely to the manufacture of a single implement. These workshops had furnished prehistoric flint implements to Hainault, Brabant, and possibly to the North of France.

M. de Munck insisted upon the last point. He had found fifteen neolithic stations in direct relation with Spiennes, which were divided among forty-five communes. The location of these workshops had given rise to a network of roads of communication that have remained in usage for a long time after. M. de Munck prophesied that searches of the same order, if pursued in other places and localities, and with other materials which composed the industries of the age of stone, would give results of much interest and benefit.

Mr. Thomas Wilson continued the discussion by a description of the quarry at Flint Ridge, near Newark, in Licking County, Ohio. In a space ten miles long and three miles wide had been found a thick bank or stratum of silex from four to twelve feet in thickness, which the aborigines had attacked by means of wells dug through the surface soil and clay. After piercing this soil or clay they broke down through the stratum of silex by means of fire, and extracted it in great blocks. The flint which was thus obtained was broken up in its place, and was spread around over the surface of the entire plateau, where its remains were found in many workshops, and the implements thus made were to be found disseminated throughout the entire state of Ohio.

M. Cartailhac described the exploitations made by himself and M. Boule in the mines of flint at Mur-de-Barrez, in Aveyron, of which he had given reproduction which was exhibited at the exposition. He said that similar wells or shafts had been found by Baron de Baye in the Department of Marne, and also many years since by Cuvier and Brongniart in the Chalk of Meudon.

Prince Poutjatine, one of the delegates from Russia, presented to the congress a superb collection gathered from the north of Moscow, near Bologoje, district of Waldai, province of Novogorod. There were a number of polished stone hatchets of various dimensions, but

generally small; worked flint in the form of points, arrow-heads and others; worked bones, arms, tools, pendeloques, ornaments, harpoons, a fish-hook in two pieces worked with a joint. He has many fragments of pottery, which had been decorated as is common among the Indians of North America; that is, by pressing upon the soft clay certain textile fabrics, strings, cords, twine, etc., which made the ornamentation.

The Prince has sent to the U. S. National Museum a series of casts, as well as several original pieces of prehistoric pottery, all decorated as above described. These were exchanged for a series from the United States. The similarity of these two series so widely distant is remarkable. The astonishment of the beholder is increased when he is told that heretofore this mode of decoration was believed to be confined to the United States, and that none except that here described have ever been reported from Europe.

The Prehistoric Man of Spy.—Among the most interesting exhibits at the recent meeting of the International Geological Congress at Washington was that of M. Max Lohest, of Liége, Belgium. Although unfortunately M. Lohest's paper was crowded out, and consequently the members had not the advantage of hearing it, yet his photographs and pamphlet were examined by several of those who combine archeology with geology.

M. Lohest's paper read before the Anthropological Congress gives an account of his investigation in the grotto of Spy, near Namur, on the property of the Count of Beauffort. In this cavern M. Lohest found, under a thick bed of rubbish and fallen fragments of limestone, three distinct ossiferous beds. The uppermost of these was in part stalagmitic, and contained a few bones of an undetermined deer, a bear's tooth, and some pieces of the bones of the mammoth. Besides these, and mingled with them, were great numbers of flint implements of various patterns, some of them resembling the type known as "Mousterien," from the cavern of that name, and others are like those found in the well-known Engis cave in Belgium. Some are notched like saws, and of very thin and delicate workmanship. They consist of scrapers, points, blades, knives, etc., worked on one face, some apparently to be set in handles, and others not.

No instruments of bone or of ivory were found in this upper layer, and the flints are mostly covered with a white or bluish patina, sometimes very thick.

Under this stalagmitic layer was a second ossiferous bed, usually red from the presence of iron ore, many fragments of which were found.

Here occurred the following fauna: *Rhinoceros tichorhinus*, abundan; *Equus caballus* (horse), very common; *Cervus elaphus* (red deer); *Cervus canadensis?* (elk); *Cervus megaceros* (Irish elk); *Cervus tarandus; Ovis aries* (sheep); *Bos primigenius* (bison); *Bos priscus* (aurochs); *Elephas primigenius* (mammoth), very abundant; *Ursus spelæus* (cave bear), scarce; *Meles taxus* (badger); *Canis vulpes* (fox); *Canis lupus?* (wolf), *familaris?* (dog); *Mustela foina* (weasel); *Hyæna spelæa* (cave hyena), very abundant; *Felis spelæa* (cave lion), a few teeth; *Felis catus* (cat); *Sus scrofa* (pig). These determinations are due to M. Fraipont, professor of paleontology at the University of Liége. Numerous hearths were also found on this layer, composed of stones, and containing burnt wood and ashes.

The materials used by the old inhabitants of this grotto were flint, phthanite, sandstone, chalcedony, opal, ivory, bone, and horn, and the total number of implements obtained was very large. There are 140 "Mousterien" points, most of them thick at the base and not intended for setting in handles, whose average dimensions are four inches long by three inches wide; a number of fine flakes and awls, and arrows or dart-heads, of very fine workmanship, some of them five inches long, resembling in type the "solutreèn" implements of the Dordogne, a single small core from which flakes have been taken, and numerous blocks rejected on account of some defect after a flake or two had been struck off, and 300 scrapers of various size and types.

Implements, etc., of ivory were more numerous in this layer than in any other cave in Belgium. Chips were so abundant as to form a breccia in one place. The objects found were for the most part for dress or ornament, and the material had often degenerated into a chalky substance. Many of them were unfinished, or the different stages of manufacture were revealed. Some of them were marked with striations, as was also the case with the implements of horn and of bone found with the ivory. On a rib of the mammoth or rhinoceros was found a series of "circumflex accents" ranged one above another, of which a figure is given in the pamphlet. One hollow horn was filled and stained with iron oxide, and is supposed by M. Lohest to have been a receptacle of this material for coloring the persons or the implements of the cavern. These with four fragments of pottery, found by another investigator, complete the list of relics from the second ossiferous layer.

The third contains a fauna, so far as it goes, identical with that of the second bed. *Rhinoceros tichorhinus*, abundant; *Equus caballus*, very abundant; *Cervus elaphus*, rare; *Cervus tarandus*, rare; *Bos primigenius*, common; *Elephas primigenius*, common; *Ursus spelæus*, rare; *Meles taxus*, rare; *Hyena spelæa*, abundant. In this bed were found, as in the other, abundance of flint implements, but somewhat different in form and material from those above mentioned. The great interest of this layer, and, indeed, of the whole find, is the discovery not only of the works of man, but of man himself, in the form of two partial skeletons, one skull of which is nearly complete. This, of course, forms the central point of M. Lohest's paper, and he justly goes into detail concerning it. We will condense his account, written by Dr. Fraipont:

"The human relics belong to the most ancient fossil race, that of Neanderthal or of Canstadt. The skulls, fairly complete, present all the ethnic characters of that race, whose remains are known from France, Italy, Austria, Germany, and Sweden. Hitherto only a single jaw has been obtained from a cave (Naulette) in Belgium."

One of these skulls is apparently that of an old woman; the other that of a middle-aged man. They are both very thick. The former is clearly dolichocephalic (index 70), the other less so. Both have very prominent eyebrows and large orbits, with low, retreating foreheads, excessively so in the woman. The lower jaws are heavy; the oldest has almost no projecting chin. The teeth are large, and the last molar is as large as the others. These points are characteristic of an inferior and the oldest-known race. The bones indicate, like those of Neanderthal and Naulette, small, square-shouldered individuals. M. Lohest adds:

"The skeletons from Spy are among the most important discoveries relating to the oldest-known race of men. The cave shows three ossiferous layers, and remains of the mammoth occur in all three. Stone implements chipped only on one face indicate the 'Mousterien' type of industry.

"The relics of the three layers indicate an advance in the character of the workmanship.

"The second layer, by its association of chipped tools with ornaments of ivory and bone, shows its close relationship to the 'Mousterien' type, and, at the same time, is free from all suspicion of accidental mixture.

"The study of the bones of the lowest level proves beyond doubt that the earliest race of men as yet known in Belgium had a skull of

the type 'Neanderthal,' and used instruments of the 'Mousterien' pattern."

In the above discovery we have at least clear and indisputable traces of the men whom up to now we have known almost entirely by their tools. A few disjointed bones not free from suspicion are now fortified by evidences that cannot be gainsaid, and the old Canstadt or Neanderthal race stands before us as an extinct but real ancestor.—***American Geologist, Sept.***, 1891.

M. Max Lohest made several visits to the Department of Prehistoric Anthropology during the International Geological Congress, and we had much pleasure in renewing acquaintance formed years ago. I had visited the Grotte de Spy along with the other Belgian prehistoric caverns, and was acquainted with his work. He had a full display of objects from these caverns at the French exposition, and read a paper before the International Congress of Anthropology and Prehistoric Archeology.

Not the least interesting episode of the geologic congress were the visits of Professor Gaudry and Marcellin Boule to the Department of Prehistoric Anthropology. They are both, like M. Lohest, much interested in the antiquity of man, and many things shown them ill appreciated by the American public were regarded by them with intense eagerness and interest.

Continuation and Close of Proceedings of American Association for Advancement of Science.—*September 30th.*—Saturday was the last and most attractive day of the meeting. It opened with a most interesting paper by Mr. Frank H. Cushing upon the outlines of Zuñi creation and migration myths in their relation to the Ka-Ka and other dramas or dances. It was carefully written, well delivered, and was a valuable contribution to the history of these Indians. The illustrations displayed were elegant, and as the paper will be published in due course, it is deemed wise not attempt a description.

Mr. James Mooney gave an impromptu and extemporaneous description of the Messiah religion and the ghost dance. Mr. Mooney spent some months among the Apache and Kiowa Indians, and had just returned with his trunk full of Indian relics and his head full of Indian stories, myths, and traditions. He had witnessed the ghost dance many times, and had innumerable photographs illustrative thereof. He did not attempt to read a paper. He talked, acted, and danced. He roused his audience to a pitch of enthusiasm rarely seen in a scientific

assemblage. Mr. Mooney stated that the present Messiah excitement is not the first of its kind among the Indians, and is not even peculiar to the race. It is only another expression of the universal longing for a happiness that died when the world was young, and a faith that in a time yet to come we shall be able to close our eyes upon present miseries and waken again to the realization of the old ideals. The Messiah doctrine is born of the despair of the Indian, who finds himself helpless and starving before the white man, and sees no hope but in the direct interference of a redeemer of the red race, who is invoked in the wild ceremonial of the ghost dance. The present agitation originated among the Poütes in Nevada, and was carried by native apostles to nearly every tribe of the plains and mountains from the British border almost to Mexico. The belief is that the whites are to be dispossed, and that the land will be restored to the Indians, together with the buffalo and other game and all the old-time Indian life. There are various theories as to how this will be accomplished, the favorite one being that a new earth, upon which are all the dead Indians, the buffalo and other game, will come, preceded by a wall of fire, and slide over this old world. The believers will be lifted up over the wall of fire by means of the sacred crow feathers which they wear on their heads, while the whites will be driven before the fire to the eastern land across the the water from which they came. In the dance they pray for the speedy coming of their deliverance, and sing of the old pleasures of the hunt and the camp, and of their present miserable condition. These songs are all plaintive in tone, and many of them are really beautiful. The great majority are in the Arapaho language. Those who become unconscious in the trance—through the intense nervous strain and the hypnotic action of the priests—catch glimpses of the glory to come, and on awaking recite these visions in songs which are taken up at the next dance. As many as a dozen frequently become unconscious in a single night, and lie for hours perfectly rigid upon the ground.

The following papers were considered as read by title and passed for want of time: An Ancient Human Cranium from Southern Mexico, F. W. Putnam. The Length of a Generation, C. M. Woodward. Burial Customs of the Hurons, Chas. A. Hirschfelder. Study of a Dwarf, Frank Baker. Stone Drills and Perforations in Stone from the Susquehanna River, Atreus Wanner. Evidences of the High Antiquity of Man in America, Thos. Wilson. On Bone, Copper, and Slate Implements Found in Vermont, G. H. Perkins. Some Archeological Contraventions, Gerard Fowke. On the Distribution of Stone

Implements in the Tide-Water Province, W. H. Holmes. Aboriginal Novaculite Quarries in Arkansas, W. H. Holmes. Games of Teton Dakota Children, James Owen Dorsey. Geographical Arrangement of Prehistoric Objects in the U. S. National Museum, Thos. Wilson. Curious Forms of Chipped Stone Implements Found in Italy, Honduras, and the United States, Thos. Wilson. Inventions of Antiquity, Thos. Wilson. Study of Automatic Motion, Joseph Jastrow. Race Survivals and Race Mixture in Great Britain, W. H. Babcock.

SCIENTIFIC NEWS.

The Ninth Congress of the American Ornithologists' Union will convene in New York city on Tuesday, November 17th, 1891, at eleven o'clock A. M. The meetings will be held at the American Museum of Natural History, Central Park (77th Street and Eighth Avenue).

Philip Herbert Carpenter, M. A., F. R. S., died October 23d. He was born in London, February 6th, 1852; was educated at Cambridge, and in 1877 was appointed assistant master at Eton College. In 1868 he was a member of the scientific staff of the deep-sea exploring expedition of H. M. S. Lightning, and was with H. M. S. Porcupine, in the same capacity, in 1869–'70. In 1875 he was appointed assistant naturalist on H. M. S. Valorous, which accompanied Sir George Nare's Arctic expedition to Disco Island. In 1883 the deceased scientist was awarded the Lyell fund by the Geological Society of London, and in 1885 he was elected a fellow of the Royal Society. He was the author of a number of valuable works, including a "Report Upon the Comatulæ Dredged by the United States Survey in the Caribbean Sea," published last year.

At the meeting of the Academy of Natural Sciences of Philadelphia, on October 20th, the committee on the Hayden Memorial Geological Fund reported that they had decided to award the Hayden medal and accompanying fund this year to Professor Edward Drinker Cope, in recognition of his researches in the domain of geology and paleontology. This is the second award of this medal of honor, the first having been made to Professor James Hall, the veteran geologist of New York, and pioneer in the field of American paleontology.

The Bulletin of the Essex Institute just issued (Vol. XXIII., Nos. 4, 5, and 6) contains the retrospect of the year 1890–'91. From it we learn that the total additions to the library number 19,102, of which 2,638 were bound volumes, 6,994 pamphlets, and 9,470 serial. The receipts for the year were $6,708.71, and the income-earning property, $71,269.10. Nine members have died during the year.

Dr. Martin Heidenhain is Prosector of Comparative Anatomy in the University of Würzburg.

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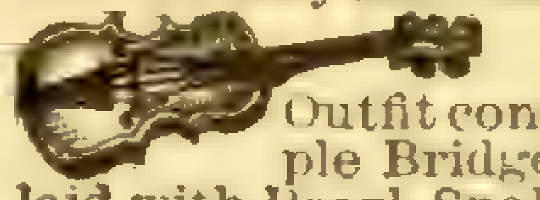

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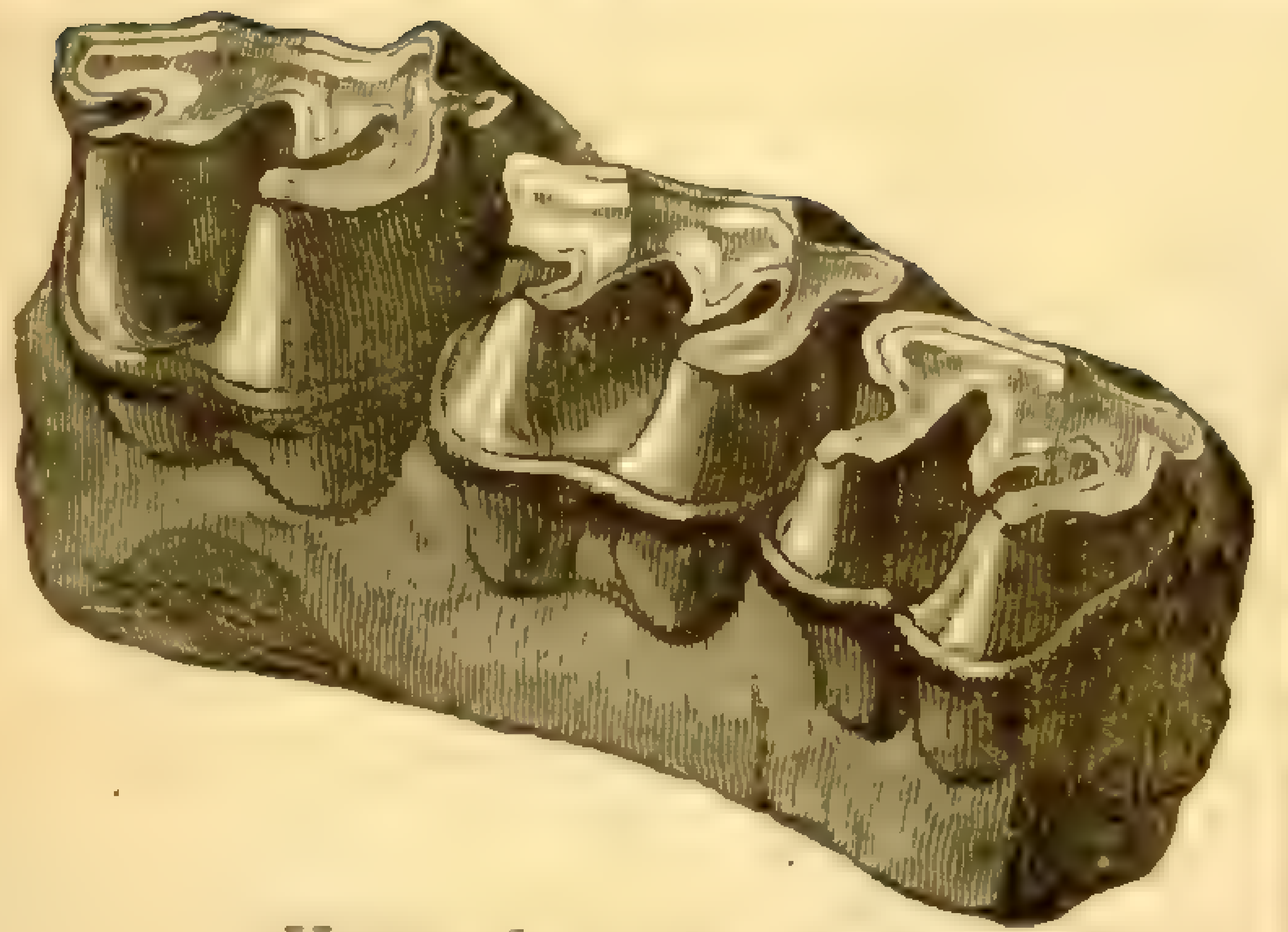
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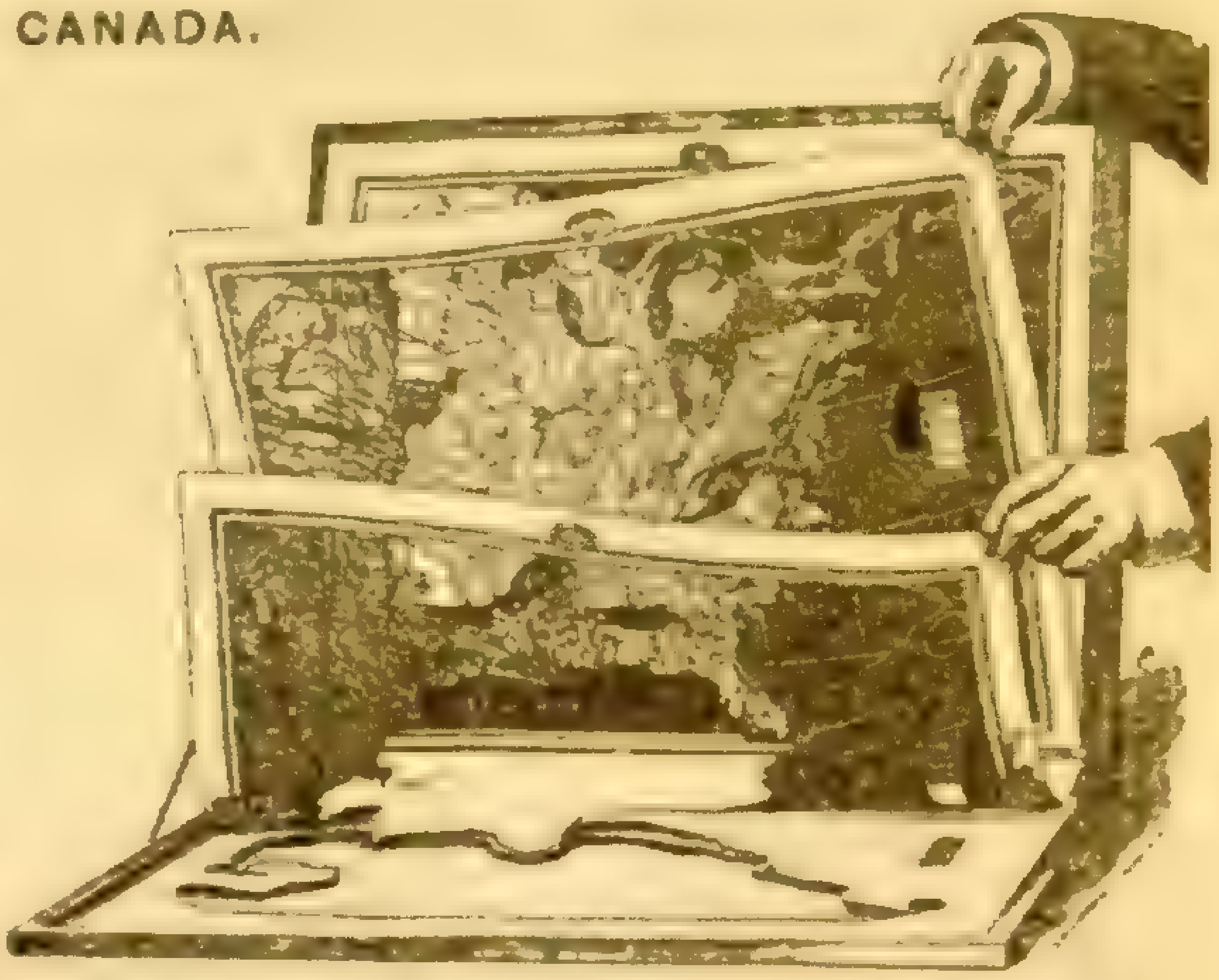

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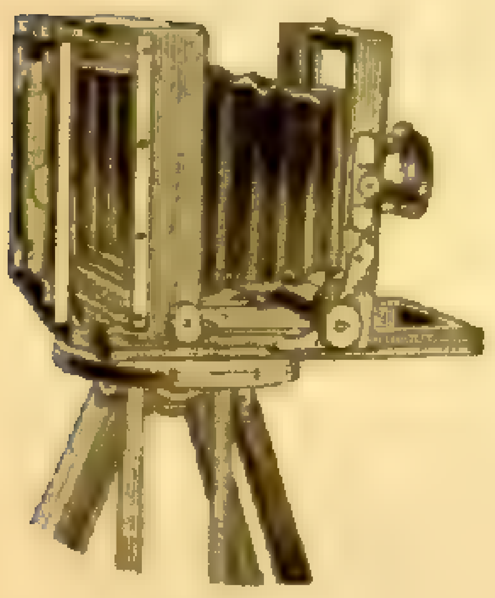

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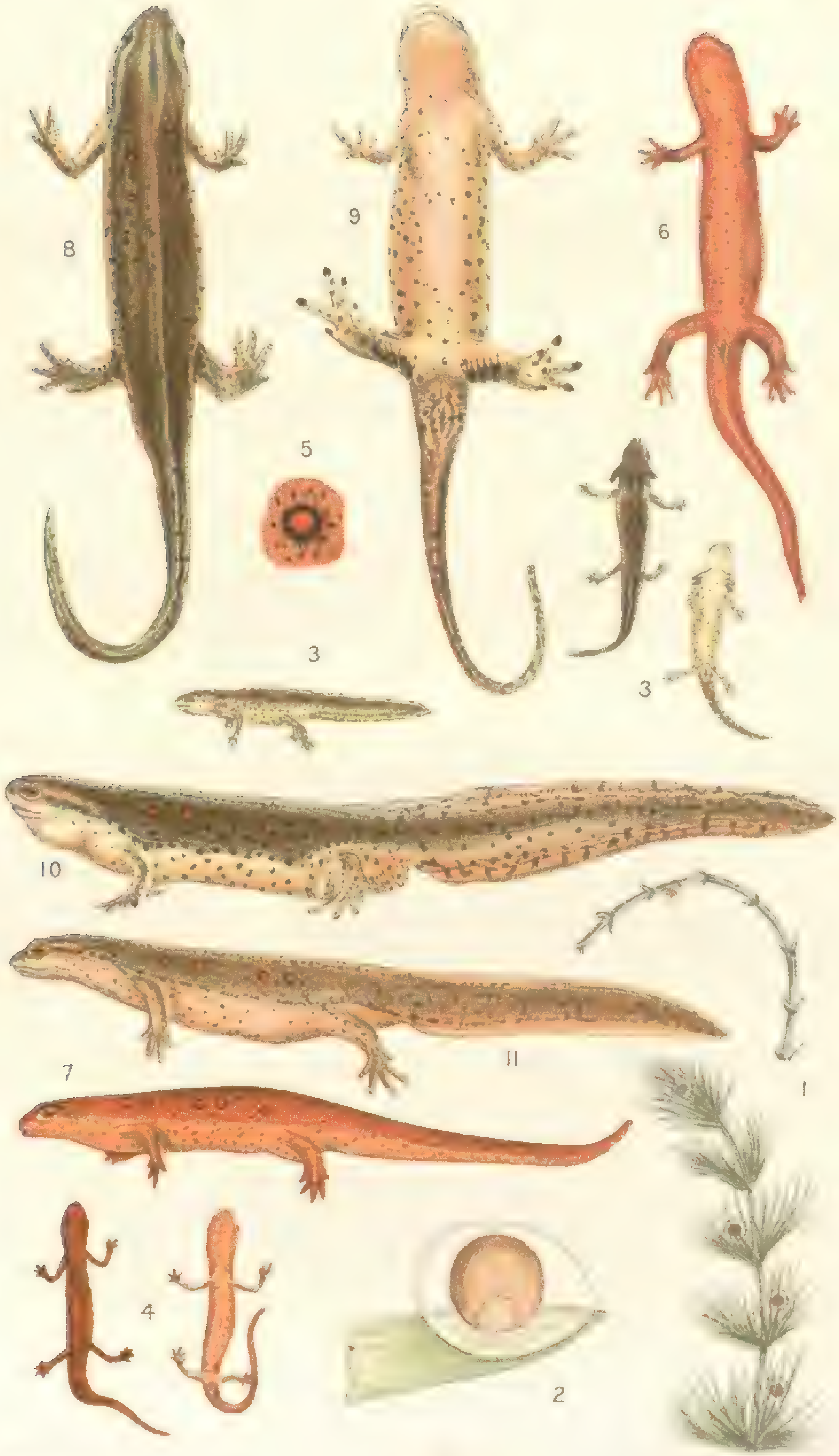
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THE

AMERICAN NATURALIST

Vol. XXV. DECEMBER, 1891. 300.

THE ISLAND OF MINDORO.

BY J. B. STEERE.

THE island of Mindoro is the Philippine land of myth. Lying near the route of the native trading boats in their voyages from north to south, and of the war and piratical expeditions for which the Philippines have been famous, it has been frequently coasted along and visited by natives of the other islands, but appears never to have been permanently occupied by them and the Spanish until very recently. It is still inhabited almost entirely by its own wild, independent tribes, many of which have probably never yet heard of the Spaniard, and know nothing of the great sea but what they have seen from their mountain homes. It is difficult to account for this fertile island lying thus uncultivated and peopled only by a few savages, while surrounded near at hand by overpeopled and overcultivated islands. Perhaps the reputation the island bears for malaria and savage inhabitants may have had its effect; while the fact that it has become the safe refuge of criminals and outlaws from the other islands about it has added to its bad reputation. We had everywhere heard stories of Mindoro and its savage beast,—the *tamarou*. One ship captain we had traveled with had lately lost a brother at the southern end of the island, where he had gone with his vessel for a load of timber. He and his company were attacked while at dinner, and all killed but one. A tribe was said to exist in the interior, of people as white as the Spaniards, but so fierce that they killed all strangers who approached their villages. The *tamarou* takes the place, in the stories of the Philippine-islanders,

of the elephant in those of other eastern peoples. Some had described it to us as a great beast with one sharp horn in the middle of its forehead; and all stories agree as to its great speed and fierceness in attacking men and other animals at sight.

We knew that the island had been but little studied in a scientific way; but our curiosity and our anxiety to visit it was much increased by the Spanish governor of Mindoro, who is also governor of Marinduque, and who visited the latter island during our stay. I asked him what scientific study of the island had been made, and he answered: "*Ni bien ni mal*" (neither well nor ill,—not at all). He said a Spanish scientific commission had landed there once since he had been governor, but had gone away without visiting the interior, for fear of the malaria. It was then with a great deal of interest that we looked across the strait to the west to the lofty mountains of the island, which were continually in our sight, and planned our trip to this unknown land. The visit of the governor was a fortunate one for us, for we found that one of the passenger steamers from the south would call on its way to Manila and take him directly across the strait; otherwise we should have been compelled to hire a native boat, or to have gone to Manila and returned from there to Mindoro. The time of the steamer was not closely fixed, so that for two or three days we were half packed up, and dared not go far away in hunting. But finally, one afternoon, the lookout gave notice that the steamer was in sight; and half an hour afterwards the goods of the governor were being hurried down to the beach on buffalo carts, and our own soon followed in the same manner, and were piled on the sand just above the tide, where they were taken by the ship's boats and carried out to the steamer, which lay at anchor half a mile away. Just at night we got on board ourselves, while the anchor was being hauled up, and after a quiet voyage across were landed, near midnight, at the port and town of Calapan, again by the ship's boats, and at a long bridge or wharf of wood supported by piles and running two or three hundred feet out into the bay. A part of this was roofed over, and some of us swung our hammocks here, while the others camped with their guns among the baggage, which was piled on the beach under

the open sky, for we had again, for the third time, outrun the rainy season in its slow advance from the southeast. The next morning showed us a bay partly sheltered by several small islands, and the little town of Calapan scattered along a low, narrow point of land between the bay and a tidal river behind. At the landing from the wharf was a little plaza, now surrounded by posts (for they lately had a bull fight there), and behind this the stone fort and its high wall, where was quartered a company of Indian troops. Behind this, a short distance, was a low bridge across the river. We were soon able to find a house for rent, and moved in and got our breakfast at home. We were fortunate in securing as cook an old Indian, Juan, who was said to have cooked for a Spaniard at some time in his life. A stroll down the street showed me a blacksmith shop, a few doors away, under an open roof of palm-thatch and bamboo, and between that and us a continuous line of native houses, palm-thatched and as dry as tinder. I had with me nearly the entire results of the year's work in the Philippines, including several dozens of new and undescribed species. The thought of our personal danger in being burned up in the tinder-box in which we lived never occurred to me; but the danger of the collections became such a burden that I could hardly sleep, and the great trunks of skins and other collections were so arranged that they could be at a moment's warning dragged down to the yard below.

Calapan is the capital of the island, and possesses perhaps a dozen Spanish officials, a few Chinese, and five or six hundred Christian Indians, the latter drawn chiefly from Luzon and and Marinduque opposite.

We were so anxious to see what the island produced that several of the party went out the same day to the patches of virgin forest on the low hills near the town. The settlement is quite recent, and stumps and native timber are still abundant. Mateo was the first to return, with a lot of birds which were at first sight disappointing. Most of the lot were birds we had already learned to expect as common inhabitants of all the Philippines; among these the common Philippine crow and oriole and barbet and black night-singing cuckoo, *Eudynamis*. Several genera which

we had learned to expect in local species in each well-marked division of the islands were wanting entirely, and our trips inland afterwards failed to discover them. Among these genera conspicuous for their absence were two of the three commonly distributed genera of hornbills, three of the four genera of woodpeckers, and several genera of kingfishers and cuckoos. Among the new birds brought in was a little parrot, Loriculus, closely resembling the Luzon species, but sharply distinct from it; and a new species of the genus of small black hornbills (Penelopides). We had found the five species of this genus already collected with the male always white-headed and the female with the head black like the body; but our Mindoro species was white-headed in both male and female, the only distinction in color between the sexes being that the male had the bare skin about the face flesh white, while the female had the same parts livid blue. A little way back among the hills another crow was found, much smaller than the common crow and with a shorter tail, and flight resembling that of the parrots. This little crow had a curious flat voice, reminding one of the croaking of frogs and also of the notes of the katydid. On dissection it proved to be distinct in food from the common species, being limited to fruit. We were soon visited by several collectors of land and tree shells,—the same ones who by sending quantities of their collections to Manila have made the beautiful Mindoro tree snails well known in Europe. The Mindoro species are apparently more peculiar than those of Paraguay, there being several sections of genera limited to this island.

The *tamarou* were said not to be found within less than two days' journey of Calapan; and as the rainy season was coming on, we hastened our preparations for our visit to the interior. That we might run the greater chance of getting the object of our search we decided to divide our party; an l Bourns and Worcester set out by native boat a day's journey down the coast to the south, and then inland in their search for the lake Naujan, which was said to be a famous haunt for these animals. They found the lake to be of considerable size, but shallow and with great mud-flats, and much of it grown up with water plants and

filled with crocodiles. It is apparently an old arm of the sea, cut off, and now draining out by the rising of the land. It is surrounded by dense forests, only broken where there are a few cabins of outlaws and runaway Christian Indians, and a little village of Mangianes, a native heathen tribe. Signs of the *tamarou* were abundant, and they immediately set to work to kill some of them. The Indian plan was to build a stockade and enclose a tame buffalo, which the *tamarou* would come out to attack at night, when they might be shot at close quarters. They tried this several nights until they were nearly eaten up by mosquitoes, but no *tamarou* made their appearance, and they then undertook to hunt them by day. Their guides were too much afraid to lead them directly to the game, and when they were near would run away. But they got several shots and wounded one or two badly, but rain coming on the tracks were washed out and the game lost; and so, after two weeks of the hardest work and exposure, they returned to Calapan without the *tamarou*, but with two wild boars and a large collection of water birds from lake Naujan.

A few days after this portion of our party left for the south, Mr. Moseley took a native vessel across to the coast of Luzon, on his way to Manila and the United States; and Mateo and I, with old Juan, the cook, loaded a canoe with provisions and started up the coast to the north to the village at the mouth of the Catuiran river, where we expected to get a guide for the trip. The man who had been recommended to us was not yet ready, and we pushed on up the Catuiran. At its mouth it is wide and deep enough for native vessels of considerable size to enter. The country near the sea was low and covered with mangroves, and uninhabitable; but as we left this flowed country behind we came to new settlements of Christian people from Luzon and Marinduque, and pulling our canoe up the muddy bank below the house of one of these, who was recognized as an official by the government at Calapan, we claimed his hospitality and slung our hammocks under his narrow roof. These people were clearing the new and rich lands along the river, and raising mountain rice. The next day of waiting was spent in hunting along the river and through the deep forests around the clearings; but little new was found,

and the same paucity of species and lack of expected genera was noticeable. While we were here, baskets of fruit called *carago* were brought to us, of a kind entirely new to me, but apparently identical with a well-known Bornean fruit. They were hanging in clusters, and each fruit was of the size of a small orange, and strawberry red and covered with soft red spines. On opening the thin shell, which was much after the manner of the Chinese *lichi*, there was found a mass of light-colored, juicy pulp surrounding a large flattened seed. The fruit was excellent in quality, and appeared worthy of cultivation, though the circumstances may have had something to do with our appreciation of it. We at the same time heard of another fruit, not yet ripe, but so abundant and rich that the wild tribes got fat upon it. This was called *uli*, and from the description as well as the name must be the *durian* of the farther east. The next day Pedro, our guide, arrived,—a man of some consequence, and an owner of land and buffaloes. He came mounted upon a water buffalo, and with a boarspear as a weapon. The river now narrowed to fifty or sixty feet of water, and a broad bar of coarse sand or shingly gravel on one side, and on the other a low bank of ten or fifteen feet, reaching up to the level forest above. The stream appeared to approach gradually nearer the mountains, which were in plain sight on the right. Little clearings were scattered along the river for several miles, and our progress was so slow that as we neared the last of these the afternoon was half spent, and we stopped for the night. The next morning another Indian, Antonio, a famous crocodile hunter of the Catuiran, who had heard of our trip, joined himself to our party in the hope of meat and pay.

We now entered the unbroken wilderness, and Pedro led the way along the sand-bar on his buffalo, and I followed him on foot with my gun, while Mateo and Juan came with the canoe. The river was now made up of curious reaches of deep and sluggish water, of half a mile or so in length; and then there would be a shallow rapid for a few yards, over which the water roared as it dashed down, and where our men had to take hold of the canoe and by their force drag it up into the quiet water above. As the heat of the day came on the sand and gravel became as hot as

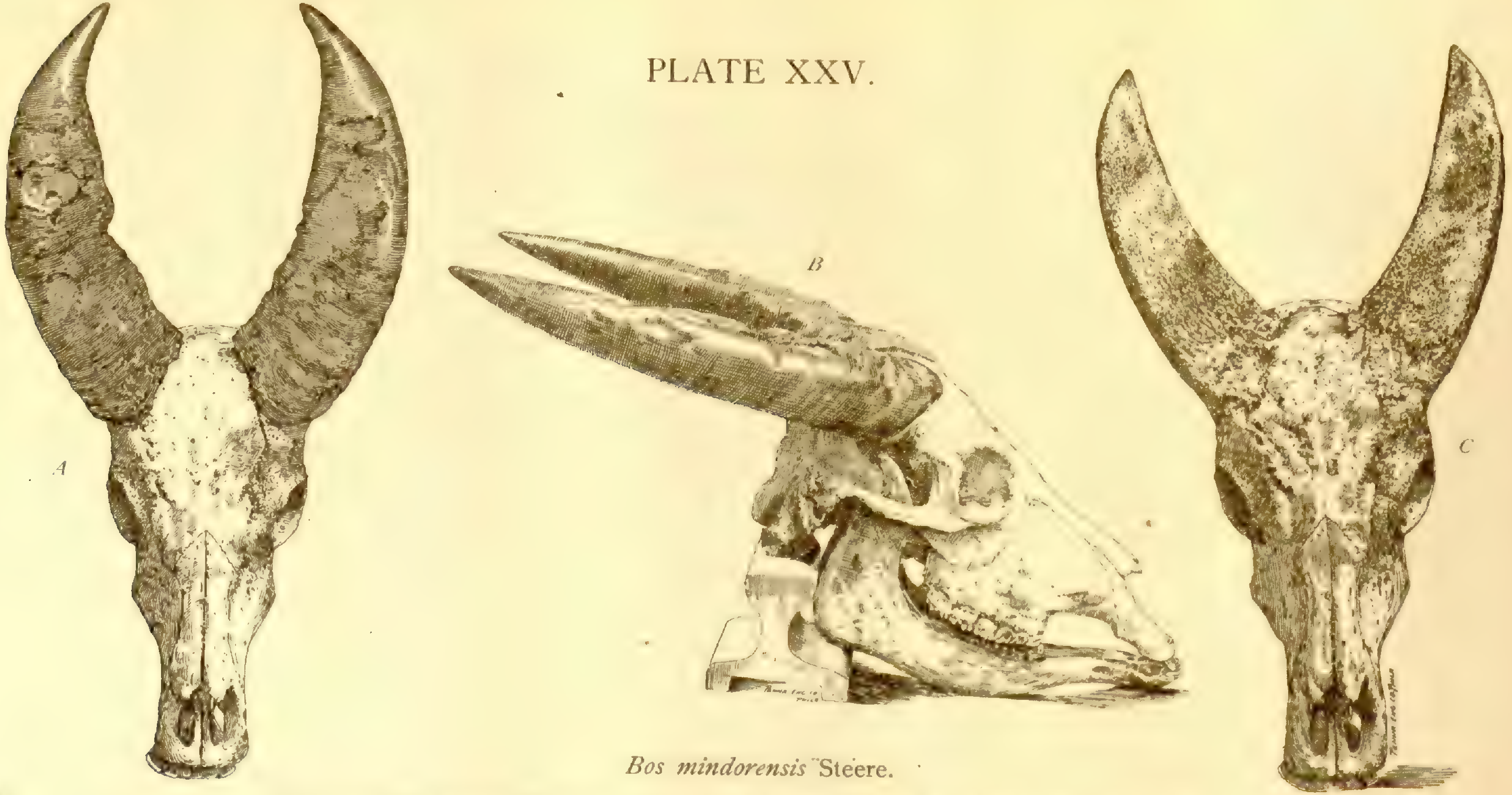
if heated in a furnace, and we would follow along under the shady side of the jungle whenever possible. Life was rare; a little kingfisher or a small gray heron would now and then take flight from among the driftwood, or we would see the great Philippine snake bird flying along the stream or perched on the driftwood, stretching its long neck at the approach of danger. On lighting in the water it would frequently sink and walk on the bottom, its head and neck standing out of the water above.

About noon we stopped at one of the rapids and waited for the canoe to come up. A snake bird I had shot had fallen in a lagoon formed in an old bed of the river, and one of the Indian boys mounted the buffalo and forced him to swim in after it. Crocodiles were plenty, so that he did not dare to go in alone. Tracks of tame buffaloes run wild, *cimarones*, were abundant and Pedro said that there were on the river somewhere some twelve or fifteen of his own run wild, with their young born in the jungle, making a herd of thirty or more. Here and there among these tracks he picked out smaller, rounder ones, which he said were the tracks of the *tamarou*. We passed soon after the mouth of a stream not now running, but with water in pools along its bed, which was called *rio muerto* (dead river), and was said to connect and give canoe passage across to the town of Calapan in the rainy season. About three in the afternoon two *tamarou* started out of the cane-brake within a few feet of us, and without breaking cover rushed into the forest behind. Pedro tied his buffalo to a bush, and taking my gun, started after the game. The canoe coming up soon after, the buffalo took fright and dashed away, and was in great danger of becoming a *cimarone*, but the whole party turned out and captured it, and Juan, the cook, mounting it, we moved on. Suddenly old Juan, who was ahead, came running back, shouting *tamarou* as loud as he could yell; and on hurrying around a bend we saw, a hundred yards away on the other bank of the river, what looked to me wonderfully like a buffalo calf,—and this did not take fright at Juan, who still kept shouting and calling down upon us all kinds of maledictions because we had no gun with us. Before the canoe came up with the other guns, two Indians (Christians)

appeared near the buffalo, and on crossing we found that they were gathering rattan, and had the calf's mother to pull the long stems out of the jungle to the beach. They had built a low shed on the beach near the edge of the woods; and as we had crowded about as far up the river as we could for the driftwood, we unloaded our canoe and set to work to add another shelter to the one existing, so as to cover our party. Some posts were set up in the ground and tied with rattan to each other and the old shed, and palm leaves were brought from the forest and tied on for a roof, and a shelter soon made, though the makers were so shiftless that I had to set them to do the work over three times before it would shed rain. Pedro, who had come in unsuccessful from his hunt after the *tamarou*, borrowed my gun again and set out up the river, and returned before night with a small wild boar, which was quickly fitted for the pot. He reported having seen two *tamarou* crossing the river. By dark it was raining, and hanging our hammocks with their mosquito nets from the posts of our shed, we went to sleep in our own new house. The Indians kept a great smoke all night to drive off the mosquitoes.

The next morning Mateo was out with the Winchester rifle soon after daylight, and just as we had got breakfast I heard the heavy boom of the gun, apparently half a mile away up the river and soon after there was another report, and then another and another was echoing back and forth in the thick, misty air from one side of the river to the other, until I had counted seven shots. Mateo was alone, and I had heard such stories of the ferocity of the *tamarou* that I was alarmed; but half an hour afterwards he appeared on the other bank below us, shouting: "I've got him, I've got him," and on my inquiring what, he answered: "An old bull *tamarou*." As he waded the river up to his middle, with the rifle above his head, I could see that his face was bleeding and his shirt torn off of one shoulder; but this was from the thorny jungle he had forced his way through, and from the sharp, cutting edges of the leaves of the wild canes. He had found a fresh track crossing the river, and followed it through the rich, soft bottom land almost as well as if in snow, until he saw the *tamarou* in the bed of a stream, drinking. After he had found a

PLATE XXV.



Bos mindorensis Steere.

A, *B*, Skull, with sheath of horns, front and profile views; *C*, skull, front view, without horn-sheath.

tree that he could climb in case of trouble, he fired at its shoulder, and it fell, but got up immediately and came on toward the smoke, when Mateo fired again, and again knocked him down; and he repeated this until the animal was within thirty yards, when a bullet through his brain finished him, and, charging up the bank, he fell back into the little brook dead. A rude sledge of poles was built and the tame buffalo harnessed to this, and we set out up the river and along the beach until nearly opposite the game, when half an hour's hacking at cane-brake and bushes opened the way to our prize. We then rolled him upon our sledge, and, tying him fast by the horns, dragged him to our camp. To have actually been the first of civilized men to see and describe a mammal of this size and importance is a rare experience, and one that is fast growing rarer, as all parts of the earth are becoming known. There was no doubt of the relationship of the beast at first sight. It was a water buffalo, but so differing in size and color and shape of head and direction of horns from the ordinary species of the Philippines as to make it not only a distinct species, but also to probably place it in another genus. Our specimen was an old male, the size of a small Jersey cow, but lower and heavier, the body and limbs being almost perfectly round, and looking as if swollen with fat. It was lead-black in color, with lighter markings on head, legs, and under parts, with thin, short hair, a little switch-tail like a swine, and nearly straight, sharp, black horns, which ran upward and backward, spreading but little more than the width of the head, and being in line at the tips with the nose and eye. This narrowness and backward set of the horns gave the animal a peculiar look, but must be especially fitted for crowding its way through the wild vines and cane-brakes where it passes its life, the nose being thrust forward as with the water buffalo, and the horns thrown back on the neck. The skin was of immense thickness, and was entirely covered with gore marks of many battles. One rib had been broken and mended, and the old fellow was just recovering from a horn-thrust clean through one of his fore legs. Whether these were marks of battles among the *tamarou* themselves, or with the *cimarones* (buffaloes run wild), we could not determine; but the

Indians with us said that they were from battles with buffaloes, and that the *tamarou*, though only one-half or one-third the size of these huge animals, would attack them at sight, and that on account of their great speed and their sharper, straighter horns, they usually conquered. A measurement of our specimen showed it to be eight feet one inch in length from tip of nose to end of tail; tail, seventeen inches to tip; tuft of hair at tip of tail, two and one-half inches; height at shoulders, three feet four inches; height at hip, three feet six inches; fore leg to brisket, one foot seven inches; horns, seventeen and three-fourths inches in length; circumference at base, thirteen inches, somewhat triangular and heavily ridged; distance between bases of horns, one and one-half inches; width of horns, eleven inches apart. After measurements of another bull and a cow proved to agree almost exactly with this, the cow being eight feet in length to tip of tail. The horns were not so large at their bases, and were farther apart, and the neck was not so thick; otherwise the size and shape were practically identical. A calf perhaps three or four months old differed greatly from the adult in color, being chestnut, with a black line along the back and black markings upon the legs. On skinning our *tamarou*, the roundness was found to be due to the thickness of the skin and the immense development of the muscles. We found that two Winchester balls had passed through the heart, and that after this the animal had been able to get up and charge, showing as much vitality as a grizzly bear. I set our Indians at work cleaning the bones for a skeleton, while I undertook to preserve the skin, which, from its great thickness and the moist weather, was a difficult matter. Our fire was now surrounded by pieces of the meat, roasting; the kettle was full of meat, boiling; and old Juan set at it to make *tapa* (jerked beef) of the balance; while Antonio, who regularly borrowed one of our guns and went out to hunt *tamarou*, and as regularly returned without finding game, took the refuse and staked it down across the river, and said that now he would catch a crocodile. The night following we had rain again, which was favorable by washing out all old tracks, and the next morning Mateo was again successful, this time killing a cow, which we got to camp in the

same way as before. Under the hot sun and the frequent rains our camp began to take on a decidedly strong odor, and meat was plenty. Word somehow got down the river to the settlement, and several Indians came up with their buffaloes, and loaded up with meat. Then for three days the weather was too rainy for Mateo to get *tamarou.* I was busy in hurrying my skins out into the air to dry, and then hurriedly folding them, and dragging them under shelter, when the showers came on; while old Juan was nearly distracted over his jerked beef, which was too high to be kept longer in our hut, and showed signs of running away of itself. A patch of open woodland lay back of our camp, and between showers I would get into this and kill a few of the great fruit pigeons to keep us in meat, while Mateo would get out whenever possible after *tamarou.* One evening he and Antonio had taken the buffalo and had gone up the river to tie the buffalo fast on the beach, in hope the *tamarou* would come out to attack it. I had already gone to bed in my hammock, which hung, covered by its mosquito net, under an open roof, and swung only a few inches above the sand. Before I got to sleep I heard a great splashing across the river, where Antonio had set a rattan lasso by the *tamarou* meat, and the Indians in camp took a torch, and crossing in the canoe, spent some time in tying the captured crocodile with rattans. I knew well how this was done. The hind and fore legs were tied over the back, and the jaws tied together, and then I was dimly conscious of their dragging the helpless fellow to the camp and tying him fast to one of the poles of our hut. In the night some time I was suddenly awakened by the sharp noise of the crocodile's jaws coming together, and by the pulling at the mosquito net and hammock curtain near one of my feet. Divining the cause, I roused the whole Indian camp by my shouts, when they pried the fellow's jaws loose, and again tying him fast, dragged him down near the river and tied him to a stake. They had tied him fast to the same post my hammock hung upon; he had worked his jaws loose, and seeing my foot move, had struck at it. The next morning a rattan rope was fastened about the crocodile's body just before the hind legs, and he was tied with some twenty

feet of slack to a sawyer in the river, just in front of our camp, and I had a good opportunity to watch him. He was terribly vicious, and would spring at anything that approached, making a hoarse, barking noise, which could be heard to some distance, and is a genuine voice. The next day we were visited by two savages of the Mangianes, as they were called by the Spanish and Christian Indians. They were much the same in color and general appearance as the Christianized races, but were smaller and dirtier. The man had a handkerchief tied about him for an apron; but the woman, who was entirely naked to her waist, wore a curious petticoat, made up of a long, narrow ribbon of braided rattan, which was wound round and round her hips, until it took the form of a petticoat, and was held in place by a band of bark cloth, passing between the legs and fastened to the waist. They were both barefooted, and the woman was armed with a wood knife and the man with rude bow and arrows. We had just killed the crocodile, and were taking the flesh from the bones to make a skeleton, and they carefully gathered the meat from the sand and stored it away, as also such pieces of old Juan's jerked beef as he considered past hope. This they threw on the fire for a few moments, and then went about chewing it with evident enjoyment. They have the reputation of eating snakes among the other Indians. They begged tobacco and salt of us, and promised to bring us wild fruit and honey. Their village was too far away for us to visit. The day after they came again, bringing a basket of the red fruit before mentioned, and a great piece of honey-comb filled with honey. It was made by the big bees (*Apis striata*), which suspend their combs under horizontal limbs. On the seventh day of our stay Mateo killed a young bull *tamarou;* and after skinning it and cleaning the bones for another skeleton, as it continued to rain and the river was rapidly rising, we concluded to return. The next morning our canoe was loaded with the heavy skins and skeletons and the rest of our baggage, and when we got in with our guns the edge of the boat was within less than an inch of the water. A box containing most of Juan's *tapa* was taken out to lighten us a little, and we started in the rain, and, without stopping, we hur-

PLATE XXIV.

Bos mindorensis Steere.

ried down the river, and after many narrow escapes in the rapids, we reached the village at the mouth of the Catuiran just before dark. To make the canoe load lighter I set out, with three of the guns, on foot to Calapan, while the rest came up the coast, and about midnight we had everything under shelter in our house. Our skins and skeletons were great curiosities to the people of the town, and a great many of them visited us to see them. From the stories and remarks of the old settlers in Mindoro we learned much that was semi-authentic in regard to the *tamarou*. It is said to be very abundant on the opposite, uninhabited side of the island, and to there come down to the sea coast. Some said the cows had a habit, when the calves were young, of taking them in time of danger on the neck and holding them with the horns, and running with them in this way. Our host, who had been on the island many years, said that there was another *tamarou* of the mountains, much smaller. This story, from what we afterwards learned, probably refers to a mountain goat. As we found the *tamarou* and observed their habits, we found them chiefly living in cane-brakes, upon the young shoots of which they were feeding. At night they would gather in some numbers along the open beaches of the river. During the morning they would feed solitarily, or lie in the mud and water of the small streams, and later in the day would take refuge under certain trees, whose branches drooped to the ground, forming an almost impenetrable shelter. The tracks and wallows under these trees showed that much of the time the *tamarou* must occupy them.

The rainy season was now fairly begun, but Mateo offered to return to the Catuiran for more *tamarou* if I wished, while I should go on to Manila. Having fitted him and old Juan out for another expedition, I took the steamer, which came along near the end of June, and after a day's voyage was back in Manila, and settled in the same hotel we had occupied nearly a year before, on our arrival in the islands. On the way across I had felt premonitions of fever, and after I had got my collections all housed and in safety, and my baggage carried to my room, I was taken with a severe attack. As soon as I had recovered suf-

ficiently, I wrote a description of the *tamarou* and forwarded it to Professor Sclater, secretary of the Zoological Society of London. He published a part of the description in *Nature*, of August, 1888, and the full description in the "Proceedings of the Zoological Society of 1889." I then made a trip to the La Laguna de Bay, a great, shallow lake, some fifteen miles in length, and lying twenty miles east of Manila, toward the mountains, where there was some timber. I collected a few days, and, with the aid of native hunters, got a fair representation of Luzon birds, in spite of continual rain, which rendered the roads of the country impassible for horses. I then returned to Manila, and as soon as possible to Hong Kong, and from there home, by way of Japan and San Francisco.

THE COMPARATIVE MORPHOLOGY OF THE FUNGI

BY JAMES ELLIS HUMPHREY.

UNTIL a very recent date the whole history of the truly morphological study of the fungi might have been epitomized in the mention of two names,—Tulasne and DeBary. Beginning with the earlier publications of the brothers Tulasne, which culminated in their monumental " Selecta Fungorum Carpologia," and continued in the " Beiträge zur Morphologie der Pilze " and other works of DeBary and his students, the contributions to our knowledge of the structure of the fungi, their polymorphic fruit forms and their genetic relationships, have increased in number and importance. But the time has come when to the names mentioned must be added a third,—that of a pupil of DeBary, though for a long time not of his "school." It is now nearly twenty years since there appeared the first of a series of quarto memoirs, of which the tenth has just been issued, which give their author his conspicuous rank among myco-morphologists. The first six of the series may be regarded as preliminary studies, which contain the early views of their author, and record the dawnings of the broad morphological ideas which are developed in their completeness in the last four numbers. It is the primary purpose of this paper to present in outline to American readers the results and conclusions contained in these last four parts of the " Untersuchungen aus dem Gesammtgebiete der Mykologie "[1] of Prof. Brefeld, of the German Academy at Münster, in Westphalia. The parts named comprise 884 pages of text, with 37 lithographed plates, and their very bulk is perhaps a sufficient excuse for the present abstract; while the importance of their contents and the light which they throw on many heretofore doubtful forms and problems render at least a general knowledge of them of the greatest importance to any one who would keep him-

[1] Untersuchungen aus dem Gesammtgebiete der Mykologie. Von Dr. Oscar Brefeld, Ord. Professor der Botanik, etc. VII. and VIII. Hefte, Basidiomyceten. Leipzig, 1888-'89. IX. and X. Hefte, Die Hemiasci und die Ascomyceten. Münster. 1891.

self in line with botanical progress. And it may safely be predicted that their influence on the future study of the fungi will be of a most positive and fruitful character.

Assuming, with all writers on the subject, that the simplest and most primitive fungi, which retain undoubted sexual characters, the Zygomycetes and the Oömycetes, have been derived from the lower Algæ, we find them developing, in common with some of the latter, two types of reproductive organs: sexual organs, which usually produce resting-spores, and non-sexual organs. Of the latter, the sporangium of Mucor may be regarded as the most primitive type. In this we find a roughly globular sac of very variable size, raised upon a stalk, from whose contents (originally undifferentiated protoplasm) have been formed, at maturity, a large number of rounded spores, varying considerably in size and determined, as to their number, by their own size and that of the sporangium in which they were formed. The closely related genus Thamnidium[2] bears similar sporangia at the apices of erect hyphæ, and others of a second sort on lateral branches. These latter, known as sporangiola, are essentially only miniature sporangia, in which the number of spores has become reduced to four, or even two. In one species of Thamnidium the terminal sporangium is often aborted, leaving only the the sporangiolia; and the relative abundance of the two forms can be largely controlled by varying the conditions of the culture. From this condition of things it is an easy step to that in which the terminal sporangium is habitually suppressed, and the contents of the sporangiole have been reduced to a single spore. This condition is realized in Chætocladium, whose reproductive organs are no longer sporangiola which set free their spores by rupturing, but "closed sporangia" or conidia. A comparison of the two species of Chætocladium shows the last stage in the reduction. In *C. fresenianum* the conidium begins its germination by throwing off its outer coat, a process morphologically equivalent to the rupture of the sporangium-wall; but no such preliminary

[2] The forms referred to in the following pages will nearly all be found described, and many figured, in the English translation of DeBary's "Comparative Morphology of the Fungi," published by Macmillan & Co.

process occurs in *C. jonesii*, in which is thus reached the full character of the conidium.

Brefeld here adopts the familiar name previously applied to certain non-sexual spores, and extends to some extent, while in other directions limiting, its application, and gives it a definite morphological value. The conidium, then, may be defined as a reproductive organ, morphologically equivalent to the sporangium, and derived from it by reduction; or as a one-spored, closed sporangium. As the author well says, we have here a theoretically ideal series of stages, complete at every point. A similar set of steps leading from the sporangium to the conidium can be traced among the Oömycetous forms, although less complete and less convincing.

Not only does the development of the conidia-bearing threads or conidiophores vary widely in different species, but within the limits of species it may be greatly modified by external conditions. The study of the structure and development of a very large series of forms of Basidiomycetes has shown that in some instances the true basidia characteristic of these fungi are accompanied or preceded by conidiophores which under certain conditions assume a form practically indistinguishable from the basidia; and the facts brought out lead irresistibly to the conclusion that the *basidium*, with its sterigmata and spores, must be regarded as a definite and unvarying conidiophore. Two species which show this relation very clearly are *Pilacre petersii*, which, formerly of doubtful relationship, is here shown to represent a special type of primitive Basidiomycete, and that which the author calls *Heterobasidion annosum* (= *Polyporus annosus* Fr., *Trametes radiciperda* Hartig).

The basidia of the various Basidiomycetes are not of a single type, and cannot be referred to a common origin. Those of the simplest of the group are divided by cell-walls into several (usually four) parts, each of which gives rise to a sterigma and spore. And here we find two forms: basidia of elongated form, with transverse divisions, characteristic of Pilacre and Auricularia and of the Uredineæ; and basidia of rounded form, divided by walls parallel to their longer axes, occurring in the Tremellineæ,

which group is considerably reduced in size by this new limitation. The fungi comprised under the groups above mentioned constitute Brefeld's Protobasidiomycetes, in distinction to his Autobasidiomycetes, which form the main bulk of the order, and have undivided basidia. Nearly all of these latter have basidia of the familiar short form, with terminal sterigmata and spores; but in the genus Tulostoma the spores are borne laterally, and the basidia resemble those of Auricularia, without their divisions.

The important point to be noted here is that the basidium furnishes the essential character of the Basidiomycetes, as was long ago recognized by DeBary in the very appropriate name of the group, although on much less substantial morphological grounds; that the basidium is more fundamental than any form of fruit body, and that the very various fruit forms have grown up within the group after differentiation of the types of basidia from their ancestral conidial forms. This subsequent development of the fruit body has produced results so striking and has followed such similar lines in the two great groups of fungi—the Basidiomycetes and the Ascomycetes—that the tendency has been to emphasize the differences thus brought about, with the result that we have lost sight of the primitive character of the basidium and the ascus.

Among the Protobasidiomycetes we find in Pilacre a fruit form of angiocarpous structure, while the other forms are strictly gymnocarpous. Of the Autobasidiomycetes, the simplest gymnocarpous forms comprise the gelatinous Dacryomyceteæ, formerly included in the Tremellineæ; the Tomentelleæ, separated from the Thelephoreæ; and the Clavarieæ. The basidium of the first-named family is somewhat pitchfork-shaped, with two large sterigmata; but in the others we meet with the typical club-shaped basidium, with small, spine-like sterigmata. In the Tomentelleæ we have clearly the primitive Autobasidiomycetes, consisting of very loose wefts of hyphæ, upon which are borne, irregularly and indiscriminately, the basidia, which arise precisely as do the conidiophores of many other fungi. These pass into the definite fruit bodies with more or less restricted hymenial surface of the Clavarieæ and of the hemiangiocarpous families, he Thelephoreæ, Hydneæ, Polyporeæ, and Agaricineæ. Follow-

ing these must be placed the angiocarpous forms, usually known under the name of Gasteromycetes. The author suggests that these last may have been derived either from the gymnocarpous forms through the hemiangiocarpous ones, or from the Protobasidiomycetes through forms like Tulostoma. It is worthy of note that development along parallel lines in the two great groups of fungi, in consequence of the acquirement of a subterranean mode of life, should have brought about such striking similarity as is presented in the fruit bodies of the Tuberaceæ and the Hymenogastreæ.

The culture of a large number of Basidiomycetes has brought to light much that is new concerning their life-histories, and emphasizes the fact that polymorphism is by no means a characteristic of the Ascomycetes alone, or even chiefly of that group, as has been thought since the Tulasnes' classic researches. Brefeld shows that in this respect there is little to choose between the two groups. Since the basidium is merely a modified conidiophore, it might be expected that the Basidiomycetes would produce, as accessory fruit forms, unmodified and still indefinite conidiophores. And such is found to be the case with a number of forms, some of which have been already mentioned. In some Tremellineæ, Polyporeæ, and other forms, conidia have been for some time known. Another accessory fruit form which is always morphologically of strictly secondary value, although it often becomes of primary importance histologically, is the chlamydospore. These occur very frequently in cultures of Basidiomycetes, and in their simplest and commonest form are short joints cut off from the fungus threads, occurring in chains and constituting members of the old form-genus Oidium. They may often reproduce themselves indefinitely under suitable conditions without a hint of their true relationships; as in the case with the form known as *Oidium lactis*. Much less common are the more highly differentiated chlamydospores formed, like the Oidia, from joints of the mycelium, which occur in Nyctalis, Oligoporus, Fistulina, etc. These forms may be restricted to special parts of the fruit body, as to the hymenium in *Nyctalis parasitica*, or to the top of the pileus in *N. astrophora*. The

species of Brefeld's new genus, Oligoporus, have special chlamydosporic fruits distinct from their hymenial fruit body, which have been long known under the generic name Ptychogaster or Ceriomyces. In cultures of some species, notably in the case of *Fistulina hepatica*, branching aërial hyphæ produce clusters of chlamydospores almost indistinguishable from conidiophores with conidia. And in nature it becomes sometimes practically impossible to say whether a given accessory fruit form is morphologically conidial or chlamydosporic. In *Mucor racemosus* and allied forms, in which this secondary fruit form is typically present, and which Brefeld proposes to separate under the generic name Chlamydomucor, it may readily be seen that Oidia and true chlamydospores represent modifications of the same form. The chlamydospore, then, is morphologically independent of and secondary to other fruit forms, although it frequently becomes the physiological equivalent of any, and may largely suppress and replace others by being introduced into the primary cycle at any stage in the development of the fungus.

The Uredineæ have been mentioned above among the families of Protobasidiomycetes which have transversely divided basidia and lateral spores. This view of the so-called "promycelium" and "sporidia" which are developed at the germination of the "teleutospores" is an old one, which has been gaining ground in recent years, and is now emphasized by Brefeld as the most tenable and philosophical one. The three spore forms, æcidiospores, uredospores, and teleutospores, are regarded as different forms of chlamydospores, which reach their highest development in this group, and, in the teleutosporic stages of Gymnosporangium and Cronartium, look toward the differentiation of a fruit body and connect with the Auricularieæ. It is pointed out that various Autobasidiomycetes produce both Oidia and true chlamydospores, and that the intermediate sterile cells found between the latter occur also in the spore-chains of Cæoma. While the germination of the other forms is purely vegetative, the teleutospore gives rise to a basidium which is typically four-spored, the one-spored condition in Coleosporium being paralleled by that in Kneiffia of the Hydneæ. Our author believes that in this fructificative germination

lies the true character of the chlamydospore, which has been lost in other groups, leaving it as the essential feature of the Uredineæ and the related Ustilagineæ. No species which has teleutospores can be considered "incomplete," the only such species being those whose teleutospores, and therefore whose basidia, are unknown. A single other fruit form is common among the Uredineæ, the so-called "spermogonium," but its relations may better be discussed in connection with those of the similar structures which occur abundantly among the Ascomycetes.

The Ustilagineæ have been a source of much perplexity as to their relationships, although the similarity of the spore-germination in many forms to that of the Uredineæ has indicated the propriety of placing these groups near together in the system. In their formation the spores of this group closely resemble those of Ptychogaster and other chlamydospores. In germination many of them produce structures which strikingly recall the basidia and spores of the Uredineæ, and a few produce merely vegetative filaments, perhaps by degeneration from the former type; while those of a large group of forms give rise to undivided filaments, each with a whorl of conidia at its apex, representing clearly the basidia of the Autobasidiomycetes. In the great majority of these fungi the chlamydospores are the only fruit form developed, but some of them produce also conidiophores with typical conidia.

The basidia of the Ustilagineæ are distinctly more primitive than those of any of the true Basidiomycetes, in that they are much more variable in form, size, and number of spores, in all those particulars,—that is, whose definiteness constitutes the true basidium. Brefeld therefore places the group, under the name of Hemibasidii, between the Phycomycetes and the true Basidiomycetes, as a connecting link; and divides it on the basis of the two types of basidia already described, into Protohemibasidii and Autohemibasidii, corresponding to the two groups of Basidiomycetes. These two groups coincide with the two families into which the smuts have been divided by Schroeter on the basis of spore-germination, the Ustilaginei and Tilletiacei.

Passing now to the other great group of fungi, we find it also especially characterized by a particular form of reproductive

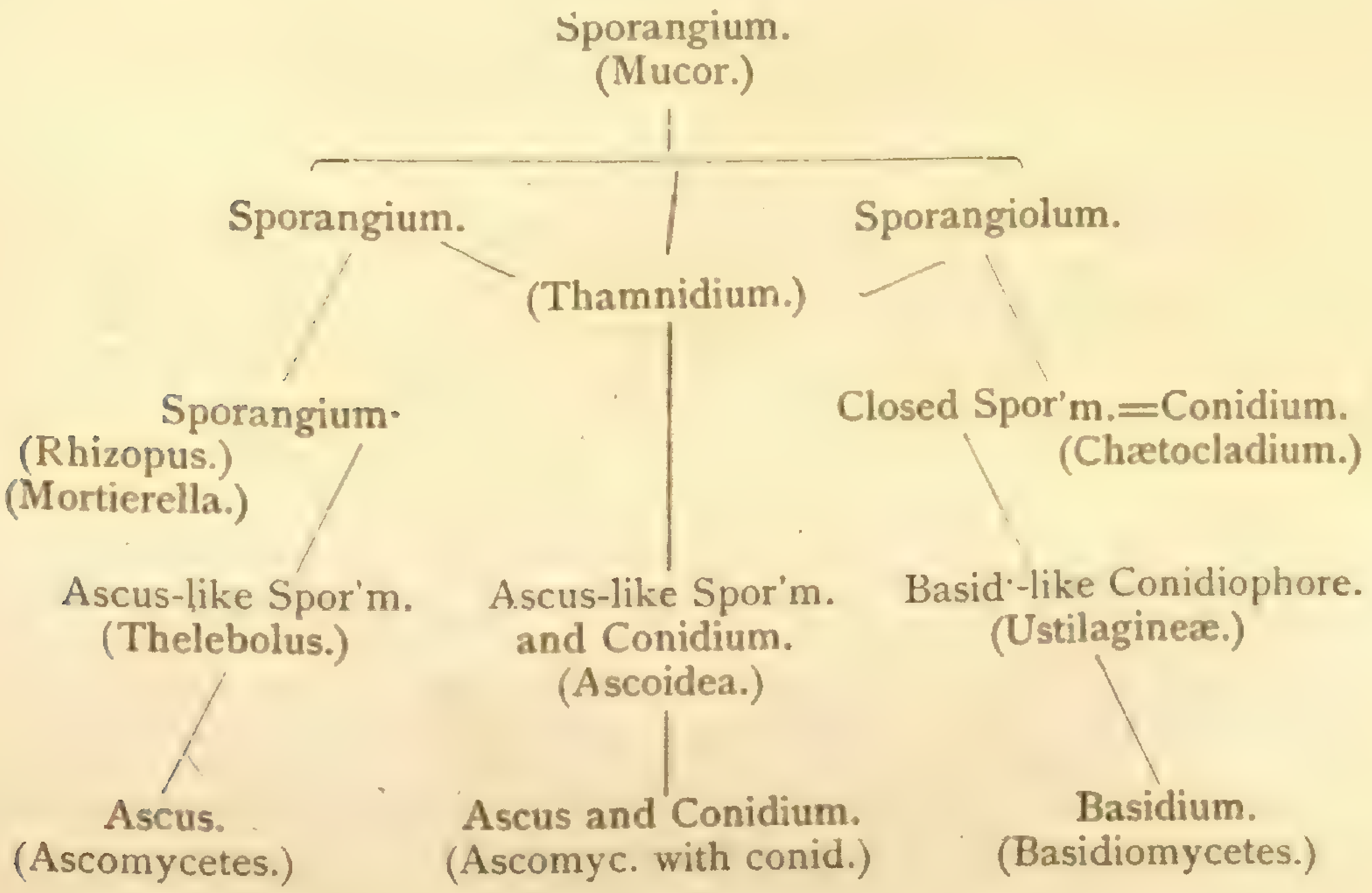
organ, the *ascus*, which has given to the order its name, Ascomycetes. This name has, however, been used in a rather more restricted sense than that of Brefeld. This is due to the fact that the characteristic of the group has been considered to be the ascus fruit, and not the ascus itself. But here, as in the Basidiomycetes, the fruit body is a secondary development within the group, subsequent to, or at most contemporary with, the differentiation of the ascus. Morphologically, the ascus is to be regarded as a reduced and definite sporangium whose form is constant, at least within the limits of the species, and whose spores, typically eight, are in most cases definite and constant in number. Intermediate conditions between the indefinite and definite extremes are distinctly to be recognized. The numerous and striking subdivisions which occur in the spores of the Ascomycetes, so useful systematically that they form the basis of Saccardo's carpologic system, are regarded by our author as germination phenomena, analogous to those seen in Dacryomyces and the Tremellineæ, which have become pushed forward into the earlier stages of spore development.

From the great body of the Ascomycetes which have a well-developed fruit body, and are called by him Carpoasci (constituting the whole of the order, according to the limitations of DeBary), Brefeld separates the forms included under Endomyces, Taphrina and Exoascus, and Ascocorticium nov. gen., as Exoasci. The members of this group, corresponding to the Tomentelleæ among the Basidiomycetes, have their asci produced, free and naked, directly from the mycelium. The Carpoasci include angiocarpous forms, the Gymnoasci, Perisporiaceæ (including Tuberaceæ), and the Pyrenomycetes; and hemiangiocarpous forms, grouped under the Hysteriaceæ and the Discomycetes. One family of the latter, the Helvellaceæ, may yet prove to deserve separation from that group. The early stages of its members are unknown, but they may be found to be truly gymnocarpous.

If we go back once more to the sporangium of Mucor, we may trace a very instructive series up to the ascus fruit of the Carpoasci. In Rhizopus we have a plant which differs from Mucor essentially in producing from a given region several

threads, some of which bear sporangia like those of Mucor (fertile threads), while others become rhizoidal (sterile threads). In Mortierella these sterile threads become woven together to form a dense capsule about the base of the fertile ones, which are long and stout. It is easy now to suppose the fertile threads reduced in length until the sporangia at their ends are withdrawn within the capsule, and just this condition is found in *Thelebolus stercoreus*, whose fruit body contains a single many-spored sporangium. From this condition a further step leads to that so familiar in the genera Sphærotheca and Podosphæra, in which the indefinite sporangium of Thelebolus has become a well-defined ascus, while the capsule is essentially unchanged. The simplest of the Carpoasci are the Gymnoasci, which have a well-marked ascus, but whose capsule consists of very loosely entangled hyphæ. Another line may be traced from some Choanephora-like form, with sporangia and conidia, through the new plant described as *Ascoidea rubescens*, which produces ascus-like sporangia and conidia, to the numerous conidia-bearing Ascomycetes.

Having seen how all of the primary fruit forms of the higher fungi, the ascus, the conidium, and the basidium, are derivable from the simple sporangium of the Phycomycetes, we may summarize the whole graphically as follows:



In the study of more than 400 Ascomycetes there has been found the greatest diversity in the time of the appearance of the ascus in the fruit body, and in its relations to the tissue of threads composing that body. In some cases the asci and the intermingled sterile threads, or paraphyses, arise as branches of the same hyphæ; or, again, the two may rise from separate hyphal systems which are differentiated early and remain structurally distinct. This distinction is never seen in the Basidiomycetes and is not to be expected, since none of their ancestral Phycomycetous forms show any such differentiation as has been described in Rhizopus and Mortierella, which are believed to represent ancestral forms of the Ascomycetes. Brefeld points out that it is this differentiation of fertile and sterile threads which has given rise to the doctrine of the sexuality of the Ascomycetes of which DeBary has been the especial champion. He contends elaborately and with the strongest emphasis that there exists no proof whatever that the so-called "ascogonium" and "pollinodium" observed in certain Carpoasci are of any sexual significance. This view, he maintains, has been reached deductively, and not inductively; by inference, and not by proof. The analogy of the sexual organs of the Florideæ has exerted a strong influence on the interpretation of the significance of the structures in question and of the so-called "spermatia," to be discussed later; yet the Florideæ and the Ascomycetes are as little related as any two groups of Thallophytes. The fusion of the initial fertile filament with one or more of the surrounding sterile filaments has no more significanc than any of the hyphal fusions, so common among fungi. It is quite as reasonable to suppose that, in the great number of forms in which this early differentiation is not observed, it has become obscured or lost in the bewildering tangle of hyphæ, as that typically sexual fungi have lost their sexual organs by abortion.

Two fungi, Thelebolus and Ascoidea, have been mentioned as having ascus-like sporangia, and as holding an intermediate place between the Phycomycetes and the true Ascomycetes. With these should be mentioned a third genus, Protomyces. This genus has been recognized as related to the Ustilagineæ, since its spores are developed from the hyphæ in much the same manner

as those of the latter group, although they germinate differently. Like those of the Ustilagineæ, its spores, as ordinarily observed, must be regarded as chlamydospores, and, like most of those, their germination is fructificative; but the product of germination is a sporangium which shows a tendency towards the more definite form of the ascus. In this view Brefeld adopts the early explanation of DeBary, the first student of the genus, which was afterwards reconsidered by him. These three intermediate forms hold the same relations to the Ascomycetes as do the Ustilagineæ to the Basidiomycetes, and similarly they are grouped together under the name Hemiasci; Ascoidea and Protomyces, with naked sporangia, constitute the Exohemiasci; and Thelebolus, with its well-developed fruit body, is the type of the Carpohemiasci. These two intermediate groups, the Hemiasci and the Hemibasidii, are made to constitute, under the name Mesomycetes, one of the three great divisions of the fungi, coördinate with the Phycomycetes and the Mycomycetes. This last group includes the true Basidiomycetes and Ascomycetes, the "higher fungi."

Of the accessory fruit forms, chlamydospores are not common among the Ascomycetes, though both Oidia and the typical form may occur. Unquestionable specimens of the latter are known in the Sepedonium and Mycogone stages of those parasites of "toadstools" and similar fungi which belong to the genus Hypomyces. While, theoretically, there is no reason why unmodified sporangia or conidiophores modified into basidia should not occur as accessory forms in the Ascomycetes, they have, in fact, never been observed; but the ordinary conidiophores are very abundant,—much more so than in the Basidiomycetes. These may arise from retrograde development of sporangia still left after the differentiation of the asci; or they may represent the conidia of Choanephora-like forms whose sporangia have become asci. They are formed either by budding from the ascospores at germination, after or even before their escape from the ascus; by abstriction from the germ-tube directly; or on distinct conidiophores. The budding of conidia from the ascospore recalls the similar cases among the lower Basidiomycetes; but it may be

forced a step farther back and take place within the ascus, giving to it an indefinitely polysporic appearance. Conidia of this type usually increase freely by yeast-like budding, like those of the Ustilagineæ; and, excepting those of the Taphrinæ, they usually develop readily, under suitable conditions, into filaments. The less specialized conidiophores have their conidia scattered over their entire length, and a gradual advance may be traced from this form to those whose conidia are wholly restricted to their tips.

Besides occurring separately, conidiophores are found grouped into dense clusters, such as have been described under the name Coremium, or into more extensive, compact "stromata." In simpler cases the surfaces of these stromata are flat; but they may be ridged or folded, and a fold may increase in depth until its edges meet, and a closed cavity is the result. Such a series may be traced in Nectria and its allied genera of the Hypocreaceæ. Closed conidial fruits which may be supposed to have originated in this way are very common among the Ascomycetes, and have long been known under the name *pycnidia*. They are known among the Basidiomycetes only in the Uredineæ and the new Tremellaceous genus Craterocella. In their development pycnidia present two types. They originate by the interweaving of previously formed threads (symphyogenic), or by the fusion of newly formed threads into a parenchymatous mass (meristogenic). Within the cavity of the pycnidium spores may be formed from all the cells or only from the terminal cells of the spore threads, just as in the case of free conidiophores. Two distinct forms of conidia may be borne on the same conidiophore or within the same pycnidium; or they may be separated, and so lead to distinct conidial or pycnidial forms on the same plant.

A fruit form very common among the Ascomycetes and the Uredineæ is that which has been known as the *spermogonium*, on account of its supposed sexual nature. This organ is structurally like the pycnidium; but the spore-like bodies developed in its cavity have been supposed, chiefly from the analogy of the spermatia of the Florideæ, on account of their minute size and the fact that they had never been seen to germinate, to be male sexual elements. But Brefeld and his pupil, Möller, have suc-

ceeded not only in observing the germination of these bodies, but in raising from them fertile mycelia, thus clearly proving them to be a form of pycnidial conidia with somewhat weakened or reduced germinative power. Thus falls another supposed support of the sexual theory of the Ascomycetes.

The conditions governing the development of the Ascomycetes are very little known. The ascus usually closes the cycle of development as the most perfect and most highly differentiated fruit form. In artificial cultures of fungi of this order it is usually found that conidial and pycnidial spores yield the fruit form which produced them, and rarely give rise to the ascus-fruit.

From what has been said above, it will be seen that all the more specialized fungi are considered to be descendants of forms identical with, or similar to, living Phycomycetous species, and to have retained none of their sexual characters, since all their primary fruit forms have been derived from, and are referable back to, the Zygomycetous sporangium. We may summarize the points brought out and the relationships indicated by means of the following tabular view :

A. Phycomycetes.

I. Zygomycetes.

Exosporeæ.			*Carposporeæ.*
With Sporan.	With Sporang. and Conid.	With Conidia.	
Mucor.	Choanephora.	Chætocladium.	Rhizopus.
Thamnidium.		Piptocephalis.	Mortierella.

II. Oömycetes.

With Sporang. or Conidia.	With Conidia.
Peronosporeæ.	Entomophthoreæ.
Saprolegnieæ.	
Chytridieæ.	

B. Mesomycetes.

III. Hemiasci.

Exohemiasci.		*Carpohemiasci.*
Ascoidea.	Protomyces.	Thelebolus.

IV. Hemibasidii.

Protohemibasidii.	*Autohemibasidii.*
Ustilagineæ.	Tilletieæ.

C. Mycomycetes.

V. Ascomycetes.

Exoasci.	*Carpoasci.*	
	Angiocarpous.	Hemiangiocarpous.
Endomyces.	Gymnoasceæ.	Hysterieæ.
Taphrina.	Perisporieæ.	Discomycetes.
Ascocorticium.	Pyrenomycetes.	

VI. Basidiomycetes.

Protobasidiomycetes.		*Autobasidiomycetes.*		
Gymnocarpous.	Angiocarpous.	Angiocarpous.	Gymnocarpous.	Hemiangiocarpous.
Uredineæ.	Pilacreæ.	Lycoperdaceæ.	Dacryomyceteæ.	Thelephoreæ.
Auricularieæ.		Nidularieæ.	Clavarieæ.	Hydneæ.
Tremellineæ.		Phalloideæ.	Tomentelleæ.	Polyporeæ.
		Hymenogastreæ.		Agaricineæ.

Such in outline are the results to which Prof. Brefeld has been led by the long and careful study of a remarkably large number of fungi of all groups and in all stages, with the assistance of the most elaborate and precise culture methods yet devised. In all his work he has had the help of trained assistants, and in that on Ascomycetes has had also the collaboration of Dr. Franz von Tavel, of Berne, whose previous researches on the development of the Pyrenomycetes are well known. One need not accept these conclusions in all their details in order to recognize the fact that they are the result of the application of a keen morphological insight to a much wider and fuller series of observations than has been at the command of any previous writer. We may regret that the author finds it necessary to introduce so much of a personal and polemic nature into some of his discussions, especially that concerning the sexuality of the Ascomycetes, or to treat so unceremoniously his former master, DeBary, and others of that school who have antagonized and criticised his views; yet it must be remembered that the provocation has sometimes been very great.

But, after all is said, we have in this characteristic work of a remarkable man a series of memoirs which must always remain classic and a prime authority for the student of the morphology of the fungi, both as the record of a great number of new facts, and as the first statement of a new and consistent comparative morphology.

Amherst, Mass.

ROCKY MOUNTAIN RHIZOPODS.

BY EUGENE PENARD, SC.DR.

DURING a stay which I made this year in the mountains of the state of Colorado I gave some of my time to the study of the fresh-water Rhizopods, comparing them with those I had observed in various regions of Europe. I should like to give here the results of my comparisons.

All the organisms which are treated of in this paper have been found in the neighborhood of Caribou, a small mining town north of Boulder, and about 10,000 feet above the level of the sea. At this altitude Rhizopods are still numerous, as Leidy has shown in his remarkable work on the fresh-water Rhizopods of North America. He found them abundant in the Uinta Mountains, Wyoming, at 10,000 feet,—the highest altitude, I believe, at which these organisms have as yet been found. However, as will be seen later, my gatherings at 12,000 feet have been very productive, which is after all not to be wondered at, knowing the very great capacity of these organisms for resisting either cold or heat, or any other disturbing element. In fact, they can be expected to be found everywhere, provided there are mosses and humidity, and if I have not found them higher (except one species, *Difflugia constricta*, at 12,500 feet), it is only because the ground was unfavorable to the presence of quiet water, and that my investigations at these higher altitudes have been very few.

I have no intention to speak about the organization and physiology of these organisms. Leidy, in his beautiful work, has treated the subject at length. I would simply like to give a list of the species I have found in the Rocky Mountains, adding some remarks about a few of them, and finishing with some observations on the structure of the shell in these animals. This structure is not very well known in most of the species; and as I have in these latter years accumulated a good many observations in this connection, I venture to detail them here, in the hope that they will prove of some interest.

I give now the list of the species I collected in various bogs or swampy grounds in the neighborhood of Caribou, and at a height varying from 10,000 to 10,500 feet. The animals were mostly found among mosses and sphagnum, whose presence at that altitude is itself remarkable.

Amœba limax Dujardin, *Amœba verrucosa* Ehrenberg-Leidy, *Difflugia pyriformis* Perty, *Difflugia arcula* Leidy, *Difflugia lucida* Penard, *Difflugia fallax* Penard, *Difflugia bacillifera* Penard, *Difflugia constricta* Ehrenberg, *Centropyxis aculeata* Stein, *Arcella vulgaris* Ehrenberg, *Arcella vulgaris* var. *angulosa* Leidy, *Arcella discoides* Ehrenberg, *Arcella microstoma* Penard, *Quadrula symmetrica* Schulze, *Lecquereusia jurassica* Schlumberger, *Nebela collaris* Leidy, *Nebela longicollis* Penard, *Nebela tubulosa* Penard, *Nebela dentistoma* Penard, *Heleopera rosea* Penard, *Assulina minor* Penard, *Pseudochlamys patella* Claparède and Lachmann, *Cryptodifflugia oviformis* Penard, *Cyphoderia margaritacea* Schlumberger, *Euglypha alveolata* Dujardin, *Euglypha ciliata* Leidy, *Euglypha cristata* Leidy, *Euglypha compressa* Carter, *Euglypha lævis* Perty, *Sphenoderia dentata* Penard, *Trinema lineare* Penard, *Trinema enchelys* Leidy, *Trinema enchelys* var. *galeatum* Penard, *Trinema complanatum* Penard, *Corythion dubium* Taranck, *Corythion pulchellum* Penard.

All these species, which did not differ in any particular from those which have been described from Europe, India, Australia, or from various parts of the United States, were generally found represented by very numerous individuals. Yet sometimes a very few were present in a given locality, or again some given species, entirely absent from one place, was abundant in another and very near one.

But there are a few of these species on which I should like to write at some length:

Difflugia pyriformis Perty.—This species is extremely variable; or rather, if I may be allowed to express a personal opinion, should be and will be one day decomposed into a large number of distinct specific forms, some of which again will show an undeniable tendency towards a great variability. In fact, my observations, which have been protracted for several years and made on

more than 200 gatherings in various localities of Europe, have brought me to the conclusion that many autonomous species of Rhizopods have acquired in their evolution and in independent ways the form *pyriformis*. Indeed, this simple and efficient shell is exactly the kind one would expect to be formed by an organism in its first stages of evolution from the amœba condition to that of a testacean Rhizopod.[1]

However it may be, if the following conditions are considered sufficient to determine a species:

1. The general characters of the shell (form, size, structure, composition) are sharp and constant in a form A, though not far distant from those of other forms B, C, etc.

2. In the state of copulation (conjugation) A is always seen together with A, and never with B or C, etc.

3. In certain localities A is to be found alone, whilst B or C are not present.

4. Intermediate forms between A and B, or C, etc., do not exist, or at least are very exceptional cases.

If, I repeat, these characters, accumulating in one and the same form, are considered sufficient to make of that form a distinct species, then it would be easy to separate the *Difflugia pyriformis* Perty in a dozen at least of such autonomous species.

Now I have observed at Caribou several different forms of *Diff. pyriformis*, and especially one that I found very abundant in several localities deserves a particular mention. With the typical form of the species, and built of angular grains of quartz, sometimes with admixture of a few diatoms, its shell was remarkable by virtue of a large amount of brownish matter (oxide of iron), dissolved in a chitinoid magma, which generally formed a brownish substratum or inside lining to the shell. Now we must observe that in those species of Difflugia whose shells are normally and essentially formed of sand particles, the proportion of

[1] At the same time, and whilst this explanation may be good in a general way, I am inclined to think that some of the forms or species so formed would still be in an unfixed state, and might be compared to such forms of vegetable life as Rosa, Rubus, Hieracium, which with their many varieties constitute the bliss of some, but the despair of most, collecting botanists.

chitinoid matter is normally very slight, and this particular Difflugia is an interesting exception.

Quadrula symmetrica Schulze.—I have found this beautiful species abundantly in most of my gatherings, but mostly represented by very small-sized individuals (length 0.040–0.060 mm.). On the contrary, in one single locality the species was to be found under what might be called a giant form (length 0.100–0.150 mm.), which presented this other peculiarity, that the square plates composing the shell, instead of being disposed, as in the typical form, in a high degree of symmetry, showed great disorder in their arrangement, and very often overlapped each other. The sides of the shell, instead of looking like a tolerably continuous curve, appeared like a series of broken short lines. These two varieties, if they must be considered as such (in my opinion, they are more than varieties), were very sharply distinct, and I have not seen any transitional forms.

Nebela collaris Leidy.—This species also was represented at Caribou by two very distinct forms: first the typical one (forma *genuina* Taranck), not very abundant as a rule, and totally absent in some places; then another form, or dwarf variety, extremely abundant, and often to be found quite alone in some localities. This latter form agrees perfectly with a variety which Leidy has figured in his great treatise (Pl. XXII., Figs. 11, 12, 16).

Nebela longicollis Penard.—Rather abundant in nearly all my gatherings. The species is very different from the preceding; yet the form I found at Caribou could hardly be referred to the *Nebela longicollis* such as I described it in 1890[2] (which appears to be the same as *Neb. barbata*,—Leidy, Pl. XXIV., Figs. 14–17). It agrees, on the contrary, very well with two shells figured by Leidy (Pl. XXIV., Figs. 18, 19) as "intermediate in character to *Neb. barbata* and *Neb. collaris*," and at the same time shows relations to the form that I called *lageniformis*. I mention here the Caribou form under the name *longicollis*, being of opinion that *Neb. barbata* and the two Figs. 18 and 19 of Leidy refer to one

[2] Etudes sur les Rhizopodes d'eau douce. Mémoires de la Société de Physique et d'Histoire naturelle de Genéve, 1890. All the species mentioned in this paper, and which bear my name, have been described in the same work.

and the same species; and at the same time I avoid the use of the name *barbata* because it appears to me to be the result of a confusion of the author, who took foreign and parasitic elements for normal covering setæ.

As already stated, those species found at 10,000 feet did not as rule show any difference from those described from the plains or in other continents, and showed the same relative abundance of individuals. Yet it will not be without interest to refer here to the utter absence of several forms of Rhizopods which one would have expected to find, and among which I shall only cite *Hyalosphenia papilio* Leidy, *Nebela flabellulum* Leidy, and *Assulina semilunum* Leidy. *Hyalosphenia papilio* is a very constant inhabitant of sphagnum-mosses; I do not think I ever found in Europe a single bunch of sphagnum that was not replete with it. *Nebela flabellulum*, according to my experience, mostly affects the mosses in the woods, yet it is very frequently found in sphagnum. As for *Assulina semilunum*, its place was taken at Caribou by the species I have called *Assulina minor*. This latter form might be considered a dwarf variety of the former, and in fact must have been so regarded by Leidy, who has figured two shells belonging apparently to it (Pl. XXXVII., Figs. 15 and 26). But besides the considerable and absolutely constant difference in size, there are others characters which decided me to make of it a distinct species, and the fact that at Caribou this form was absolutely the only one to be met with would constitute, if necessary, further proof of the correctness of my decision.

I come now to the list of the species that I found in the mosses of a swampy pasture-ground, under the summit of the hill called Bald Mountain, and about 12,000 feet above the level of the sea. Sphagnum does not grow at so high an altitude, and consequently was not represented among these mosses: *Amoeba* ———, sp. nov.? *Difflugia pyriformis* Perty (small variety), *Difflugia constricta* Ehrenberg, *Difflugia rubescens*, sp. nov., *Nebela collaris* Leidy (and small variety), *Nebela longicollis* Penard, *Nebela dentistoma* Penard, *Arcella microstoma* Penard, *Pseudochlamys patella* Clap. and Lachmann, *Heleopera rosea* Penard.

All these species were to be found in very numerous individuals; in fact, as numerous as 2,000 feet lower down. Yet to that list ought to be added: *Euglypha ciliata* Leidy, one specimen; *Trinema lineare* Penard, one specimen; *Assulina minor* Penard, a very few specimens.

An interesting fact seems to me to be that, with the exception of the very few individuals belonging to the three latter species, which I found after much exertion among hundreds and hundreds of other rhizopods, all the species mentioned in the list belong to the section of the Rhizopoda known as "Lobosa,"—*i. e.*, with broad and blunt pseudopodia. The section "Filosa," [3] including those Rhizopods with filiform pseudopodia (Euglypha, Trinema, Sphenoderia, etc.), so rich in species, and yet more so in individuals, which generally swarm everywhere and outnumber the Lobosa, have been found to be practically absent at a height of 12,000 feet. My observations, which concern only a single locality, are not sufficient to enable me to draw from that absence any certain conclusions; yet, at any rate, they seem to show a remarkable difference in the vital resistance between those two great divisions of fresh-water Rhizopods.

Among the species mentioned in the list I find two of them which must be dealt with at some length:

Difflugia rubescens, sp. nov.—Very likely this form has been seen by Leidy; indeed, he figures two shells which I think must be referred to this organism (Pl. x., Figs. 24, 25) as belonging to *Difflugia pyriformis*, and with the statement "with brown endosarc." But we have most certainly here a distinct species, which I shall call *Difflugia rubescens*. It was very abundant. I have examined several hundreds of specimens, which have all proved to be remarkably constant in form, size, and structure. The shell, pyriform, not compressed, not quite twice as long as broad (length, 0.030–0.035 mm.), consists first of a pellicle of clear chitinoid material, always covered with diatoms. These

[3] Leidy separates the fresh-water Rhizopods into two great divisions, Lobosa and Filosa. This corresponds, in fact, to two very natural groups; yet I must mention that a few Rhizopods (Cyphoderia, Cryptodifflugia, some Pseudodifflugia, and some Amœbæ) show intermediate characters in their pseudopodia, which are capable of passing from one form to another in a comparatively very short time.

diatoms, though belonging always to small species, occupy, each of them, a relatively large place on the shell, and give rise to a very general deformation of its otherwise regular contours (as indicated by the chitinoid substratum). Sometimes among the diatoms are to be found one or two quartzose grains. In the main the structure of the shell is the same as that of *Diff. bacillifera* Penard, but the form and size are different. Besides,—and this is the most important character of the species,—the plasma has normally and constantly a beautiful brick-red color, resembling that, for instance, of *Vampirella lateritia* Fresenius. It would have been interesting to investigate if in this species the pseudopodia present in their outstretched state the general colorization of the plasma. Unhappily all the animals were at the time of examination retracted in their shell and in course of encystment; and in spite of observations extending over a space of more than two weeks, I have never noticed an extended pseudopod. Yet from analogy with what I have seen in *Vampirella lateritia*, and in an Heliozoon (*Artodiscus saltus* Penard), I am inclined to think that the pseudopodia, or at least their terminal parts, must be deprived of colored matter. It is perhaps not useless to add that the red color had certainly nothing to do with foreign matter, algæ or digested products. The nucleus, generally invisible, was nevertheless sometimes quite distinct; acetic acid brought it easily to view. It did not differ in any respect from the nuclei of other Rhizopods. No contractile vesicle was present, owing very likely to the encysted state of the plasma.

Amœba ———, sp. nov.?—This amœba was rather abundant, and very constant in its form and organization; yet I have not followed it long enough to describe it as a new species. It was very small (diam., 0.010 mm., without the pseudopodia), and consisted of a spherical, clear body, normally covered by a layer of greenish, but not shining, transparent globules, finely punctulate, about 0.002 mm. in size, and forming a continuous envelope. These globules were apparently of protoplasmic nature, and a product of secretion of the animal itself. They were mostly associated with a small number of shining, irregular particles of what appeared to be amorphous siliceous matter. Sometimes, how-

ever, these particles were present in such abundance that they built up the greater part of the envelope and took the place of the protoplasmic globules, which were then only few in number. The pseudopodia were mostly much elongated,—four or five times as long as the diameter of the animal, or more,—very slender, and gradually tapering from the base to the summit, which was filiform. They were straight, rigid, few in number (about half a dozen), and were capable of radiating in every direction, while the animal walked on their points. At other times the animal would crawl along the grounds, slightly compressed at its point of contact, and then the pseudopodia would be shorter, less rigid, and flattened.

The nucleus and the contractile vacuole could not be seen, being hidden behind the envelope of globules. In short, this species recalled very much the *Amœba radiosa*, from which it was distinguished by its constant protective envelope, as well as by its very much smaller size.

Having in the preceding pages given a description of the Rhizopods I found in the Rocky Mountains, I should like to present a few general remarks on the structure of the shell in these animals.

These organisms have sometimes been divided into "Nuda" and "Testacea." There exist some transitional species, whose plasma is simply hardened on most of its surface, or covered with protective granules, or is even differentiated into a genuine double-contoured, supple, and membranous covering. But in what follows I shall only treat of the true "Testacea," with a solid and rigid shell. The Testacea constitute by far the greater part of fresh-water Rhizopods.

The nature of the shell in these beings is as yet little known. Generally speaking, and after consulting most of the works that have been written on these animals, one arrives at the following conclusion: The shell of the fresh-water Rhizopods is chitinoid, often with an admixture, in various proportions, of siliceous elements (sand grains, diatoms, scales).

My observations, which have been made on nearly all the known species, allow me to modify the preceding opinion, and to

present the following statement, which holds good for all hard-shelled Rhizopods:

The shell of fresh-water Rhizopods is composed of two elements: (*a*) Silica, always in the form of detached pieces, and forming most of the mass of the shell; (*b*) chitinoid, or chitino-siliceous matter, serving as a substratum or soldering magma.

(*a*) SILICA.

Silica is first found represented by fine particles of sand. In this state it generally constitutes nearly the whole of the shell in the genus Difflugia, especially in the species of this genus which frequent the bottoms of rivers or clear-water ponds. In these latter species the amount of chitinoid matter is so small as to be scarcely discernible, and the shells, when compressed, show hardly any elasticity, their various elements or sand particles being easily disaggregated.

Besides being found in Difflugias *sensu stricto* (denoting thereby those species of the genus whose shells are normally built of quartz grains), silica in the state of sand particles can be found in many Rhizopods (Difflugia in part, Centropyxis, Heleopera, etc.), but in these cases generally forms a part only, and not an important one, in the constitution of the shell.

I must mention here a very curious fact, to which I called attention in 1880, and which the observations I have since made at Geneva on a new interesting species have shown me to be of more frequent occurrence than I at that time thought; namely, that in certain species (*Diff. lucida*, *Diff. fallax*) the shell, very much like that of one built up of true sand particles, is in reality covered on its entire surface with amorphous siliceous elements, transparent, colorless, often rather flattened, less angular than real stones, a product of the animal itself, and constituting in these species a remarkable case of mimicry.

Very often, and in numerous species, silica is to be found as amorphous plates or scales, seldom alone (*Heleopera rosea*), more often mixed up with sand grains or other elements (diatoms).

Diatoms are very frequent in a great number of species (Difflugia i.p., Pseudodifflugia, Centropyxis, Lecquereusia, Nebela, etc.). It

is very seldom that they constitute normally the total covering of the shell (*Diff. bacillifera, Diff. rubescens*); yet, even in species where as a rule these algæ only make up a part of the envelope, one may always expect to find isolated specimens where they constitute the total covering.

All the siliceous elements which I have until now mentioned are irregular, either in their form or in their relative sizes on the shell; but there exist a whole series of genera where these elements are conspicuous by their geometrically regular form. However, before speaking of these I shall mention some forms which occupy a somewhat intermediate position. They belong to the family of Nebelidæ. In this family the siliceous elements are represented by regular circular or oval discs, contiguous with each other and covering the whole shell. Sometimes all these discs are very nearly of the same size all over the shell, at other times large ones are mixed up with very much smaller ones. These discs are generally very conspicuous, but in the genus Hyalosphenia and in some Nebela they cannot be seen, and the shell looks as if it were composed of a continuous chitinoid membrane. Yet in these species it is most probable that the discs really exist, but are very thin, and hidden in the abundant chitino-siliceous matter of the envelope.

We now come to those genera in which the siliceous scales have regular forms and are symmetrically disposed. The genus Quadrula is remarkable for its square, colorless scales, touching each other with their borders and arranged in regular series. In the numerous species of Euglypha the plates are oval, sometimes circular, seldom cordiform, but always perfect in their shape, disposed in diagonal series over the whole shell, and slightly overlapping each other. The circular or oval plates of Sphenoderia, Trinema, Placocysta, are also perfect; but in some species, owing to the form of the shell, they may vary very much in size in different regions of the shell. In the *Assulina semilunum* the plates are elongated, very thick, and often incline to a slight asymmetry. In *Corythium dubium* they are still all alike, but have more the shape of an elongated rectangle.

(*b*) CEMENTING MATTER.

In all testaceous Rhizopods the siliceous elements are cemented by or sometimes lie on a substance which may be called chitinoid, or rather chitino-siliceous. This matter, often quite transparent and colorless, but sometimes colored,—yellow, dark purple in some Arcellas, pink in *Heleopera rosea*, chocolate-brown in Assulina,—is more or less abundant according to the species. Nearly absent in the Difflugias *sensu stricto*, and in very small quantity in Euglypha, Quadrula, etc., it varies considerably in thickness in the series of species, generally making an internal varnish to the inner side of the shells, thence penetrating between the plates or other siliceous elements, sometimes overlapping them at the outside, and forming as it were relief veins or exudation droplets. But it never makes up the entire mass of the shell, and it is only very seldom (Hyalosphenia) that it constitutes the principal mass of the same.

I have called this matter chitino-siliceous, because, in fact, I am inclined to consider it as consisting of a mixture of chitinoid matter and of an infinity of extremely small siliceous particles imbedded in the magma. This is but a supposition, yet it may perhaps give an explanation of the following facts: This matter, in the pure state and without admixture of foreign elements, as it occurs for instance in the genus Centropyxis, resists the action of red heat (blow-pipe) or of cold, concentrated sulphuric acid, but disappears completely in boiling sulphuric acid. This I would explain by saying that in both cases the chitinoid matter is dissolved, but that whilst by mere heating the siliceous particles becomes soldered to each other during the process, the convection currents in the boiling sulphuric acid disperse them. The following experiment explaining the relations between the plates of the shell on the one hand and the connecting matter on the other, may at any rate give some probability to the explanation just given concerning the chitinoid matrix: I have found that the shells of all the testaceous Rhizopods resist both red heat (blow-pipe) and cold, concentrated sulphuric acid, but that this acid when boiling, after separating the plates from each other,

disperses them so widely in every direction that it is generally impossible to find them again. Yet, if one takes the precaution to isolate a shell (say Euglypha) in a very small drop of acid, one finds after the action of the boiling acid all the plates again; but they are dissociated from each other, and in a little heap. In this case the chitinoid matter is gone, and has left only the pure siliceous plates.

At the same time, it must be added that in some species the cementing matter seems to be purely chitinoid in some regions of the shell; for instance, about the mouth in *Sphenoderia dentata*, *Corythium pulchellum*, and others.

There are two genera of which I have not yet spoken, and concerning which I should like to say a few words,—namely, Cyphoderia and Arcella.

The shell of Cyphoderia, with its elegant covering of small, regular, hexagonal alveoli, is very currently considered to be made up, first, of an internal, brownish, chitinous pellicle, and then of an external envelope, itself consisting of hexagonal, chitinous prisms. The experiments I made at Geneva on this species have shown me that it is not so. In reality, the internal chitinoid pellicle is covered over its whole surface with small discs, or rather cylinders, consisting of pure silica. These I was able to isolate and examine on all their faces. They are circular in section, about one-third larger in diameter than in height, flat, or very little excavated on their upper and lower faces, and have altogether the form of fish vertebræ. Their diameter is in the bigger shells (var. *major*) about 0.002 mm.; their size is uniform over the whole shell. They are disposed with a wonderful regularity, touching each other by the borders, and cemented together by the chitinoid matter which penetrates into the interstices and often flows out to the outside. The appearance of hexagonal alveoli is a result of the juxtaposition of all these small cylinders and of the interposition of the cementing matter.

As for the shell in Arcella, I feel confident that it is analogous to that of Cyphoderia; but the siliceous elements are very much smaller, and the experiments I have made have not been decisive. Yet I have seen on broken shells that the lines of fracture were

covered with denticulations of uniform size, as they are seen on broken shells of Cyphoderia, each tooth representing a siliceous disc. I ascertained also that these shells resist very well a red heat, but after the action of boiling sulphuric acid I was not able to find the discs with certainty.

As for the origin of all these regular siliceous elements in Rhizopods, it is well known now that it must be looked for in the plasma itself. The animal has the power of secreting these siliceous plates in the very inside of its body, and in many species (Quadrula, Euglypha, etc., etc.) these plates can be seen very frequently in the plasma, either lying there without any order, or, on the contrary, disposed in regular layers. I will mention here that the species Cyphoderia has always been described as very generally containing, especially at the posterior part of its plasma, a considerable number of shining, very refractive grains, that were supposed to be starch or excretion granules. Now I have been able to isolate these granules, and to satisfy myself that they resist both red heat and boiling sulphuric acid,—a fact which proves them to be siliceous, and to represent nothing but plates in course of formation, destined ultimately to build up another shell. It is well known, indeed, that these reserve plates (Reserveplättchen), as they have been called, will not be of any use to the animal that formed them, but serve to make up a shell for a new animal. An individual A, for instance, full of reserve plates, expels these plates through its mouth, together with some of its own plasma. The whole plasma becomes highly vacuolated, and thus augments in volume; the expelled portion, still attached to the mouth of the parent, takes the form of the species, and the plates are disposed as an outer covering, and in the most beautiful order.

These reserve plates are certainly a product of the animal itself, which has thus the power of secreting silica. Besides, from very numerous observations on shells (especially Nebela) on which all transitions are to be seen from perfect diatom cases to very simple rods that have lost all precise form, it appears certain to me that, as Wallace suggested, the plasma of Rhizopods has the power of deforming and partly dissolving the shells of diatoms.

Sometimes, however, some of the investing elements can be seen which must have been directly deposited on the shell from the outside,—inorganic particles and diatoms which are much too large ever to have gone through the mouth of an individual belonging to the species.[4] At other times, again, the whole shell seems to have been formed by external apposition, as in many specimens of *Pseudodifflugia hemisphærica* which I have examined, in which nearly the whole of the shell was made of diatoms, still containing their plasma and their yellowish or brown chromatophores.

Before concluding, I would emphasize the constant dislike of Rhizopods for limestone. Not only are limestone countries always poor in Rhizopods, as Leidy showed in 1879, but even species that easily endure the presence of lime will never use any particle of it for the building of their shells. In the spring of this year I examined numerous species of Difflugia which inhabited the muddy bottom of Geneva. This mud, under the microscope, is seen to be composed of a mixture in nearly equal proportions of very fine particles of quartz and transparent limestone. A little chip of limestone, two- or three-thousandths of a millimeter in diameter, often very closely resembles another such chip of quartz. Without a careful examination a professional observer might easily be deceived; but a Difflugia is not, and will always choose quartz particles for the building materials of its shell.[5]

[4] Indeed, in some forms (*Difflugia bacillifera*, *Diff. rubescens*) this seems to be the only way in which the shell can be built.

[5] Besides these Rhizopods, I have found, of course, mixed with them, many other organisms,—Infusoria, Flagellata, Rotifers, Nematodes, etc. Of these I will cite only two Cilioflagellata, *Glenodinium cinctum* and *Peridinium tabulatum*, and three Heliozoa, *Actinophrys sol*, *Heterophrys* —— ? *Acanthocystis myriospina* Penard ? (*Acant.* —— with simple spines, Leidy); fine specimens of this latter were abundant at 12,000 feet

LIFE-HISTORY OF THE VERMILION-SPOTTED NEWT (*Diemyctylus viridescens* Raf.)[1 2]

BY SIMON HENRY GAGE.

THE working out of the complete life-history of this newt hsa extended from 1819–1820, when Say and Rafinesque first considered it, until the present year (1891). During this period of seventy-two years it has been the subject of numerous investigations; but from the striking changes in coloration, habit, and structure passed through in its various stages of development it has proved unusually puzzling to the naturalist and physiologist. The phases in its life-history are briefly as follows:

1. The ova are laid in water, and give rise to larvæ with well-developed gills. In course of development these larvæ assume the vermilion spots and general viridescent coloration of the adult.

2. The gills are absorbed, the viridescent coloration changes to a yellowish-red of varying brightness, the vermilion spots remain, the oral epithelium changes from a stratified non-ciliated to a ciliated epithelium, and the respiration and life become wholly terrestrial.

3. In from two to three years the newt changes its red for a viridescent coloration, returns to the water, loses its ciliated and regains a stratified non-ciliated oral epithelium, and reassumes a partial aquatic respiration, and during the remainder of its life is properly an aquatic form.

Historical.—In Vol. I. of the *American Journal of Science*, Say ('19, p. 264) under the name of *Salamandra punctata* Gml. gives

[1] Synonymy, modified from Cope ('87, p. 207): *Triturus* (*Diemyctylus*) *viridescens* Raf. ('20), *Triturus* (*Notophthalmus*) *miniatus* Raf. ('20), *Salamandra punctata* Gml. Say ('19, p. 264), *Salamandra dorsalis* Harlan ('27, Vol. VI., p. 101), *Salamandra symmetrica* Harlan ('25, Vol. V., p. 158), *Salamandra millepunctata* Storer ('38, Vol. III., p. 60), *Salamandra greenii* Gray (Griff. A. K., IX. Syn., p. 107), *Salamandra coccinea* DeKay ('42, p. 81), *Triton dorsalis* Holbr. ('42, Vol. V., p. 77), *Triton millepunctatus* DeKay ('42, p. 84), *Notophthalmus viridescens* Baird ('50, p. 264), *Notophthalmus miniatus* Baird ('50, p. 284), *Triton punctatissimus* Dum. Bibr. ('41, p. 154), *Triton symmetricus* Dum. Bibr. ('41, p. 154), *Diemyctylus miniatus* Hallowell ('56, pp. 6–11), Kelley ('78, p. 399), *Triton viridescens* Strauch ('70, p. 50), *Molge viridescens* Boulanger ('82, p. 21).

a very good description of the viridescent form, and near the end adds: "The younger specimens vary considerably in being on many parts of the body destitute of black punctures, and in having the dorsál and ventral color of the same pale orange. It is decidedly aquatic." As the last sentence follows without explanation, it apparently applies to both the young and the old, and is rather confusing.

The year following Rafinesque, in placing several Urodeles in his new genus Triturus, remarks with reference to the adult Diemyctylus: "It must form a peculiar subgenus Diemyctylus"; and with reference to the red form he says: "It has almost the characters of the subgenus Diemyctylus, but differs from it by having the toes of the fore feet free and unequal, the lateral ones much shorter, whence it may form another subgenus, Notophthalmus." That is, the adult viridescent and the immature red form were by Rafinesque placed in different genera.

This was continued by some authors, as DeKay; by others the two were placed in the same genus, although considered specifically distinct. It thus continued until 1850–'51, when Baird put both in the same genus, and remarks concerning them: "The salamanders were formerly divided into two great genera, Salamandra and Triton, the former with rounded tail and terrestrial habits, the latter with compressed tail and aquatic. The necessity of further division has, however, become apparent, and the old distinction into land and water salamanders is no longer tenable as parallel to any anatomical features. Thus, of the highly natural genus Notophthalmus (Diemyctylus) one species (*Diemyctylus viridescens*) is the most aquatic of all American forms, the other (*D. miniatus*) the most terrestrial; yet the

Common Names.—1. Of the adult aquatic form: Spotted salamander, aquatic salamander, many-spotted salamander, common triton, spotted triton, crimson-spotted triton, spotted newt, water newt, eastern water newt, common newt, spotted eft or evet. 2. Of the red form: Scarlet salamander, yellow-bellied salamander, symmetrical salamander, red lizard, little red lizard, rain lizard, red salamander, red newt, red eft or evet.

Distribution.—Representatives of the genus Diemyctylus are found in Europe, Asia, and North America. In North America are two well-marked species,—the *D. torosus* of the Pacific slope, and *D. viridescens*, the subject of this paper, throughout a large part of the eastern region. (Cope, '87, p. 202.)

[2] The numbers in parentheses refer to the bibliography at the end of the paper.

two are so much alike in shape as to render it a matter of some difficulty to distinguish them."

Five years later this close similarity of the red and aquatic forms so clearly enunciated by Baird lead Dr. Hallowell ('56) to express the opinion that "*Diemyctylus viridescens* and *D. miniatus* are probably the same, the orange color and roughness being appearances which, the female more especially, presents after a long sojourn on land. At least this may be inferred from the known habits of the European Tritons."

Again, three years later Cope ('59) says: "We include in the above synonyms (of *Diemyctylus viridescens*) those of the nominal species *D. miniatus*, which we think with Dr. Hallowell ('56) is a state of *D. viridescens*. We have caught specimens . . . of every shade of color between vermilion and brownish-green. The color or character of the skin seems to be dependent upon the amount of moisture in the situations in which they are found. Those from high and dry spots are redder and rougher than those from marshy situations. Thus it is probable that this species undergoes changes similar to those of the European Tritons."

During the next twenty years opinions pro and con were expressed by various systematists, but the final and satisfactory proof of the identity of *Diemyctylus viridescens* and *D. miniatus* was given by Dr. Howard Kelly ('78), who "brought home a number of *Diemyctylus miniatus* Raf., or little red lizard or red eft, and after keeping them in a dark box filled with saturated moss, they changed their color from a bright vermilion to the olive state characteristic of the *D. viridescens*." The change took place in the autumn, and without entering the water, although they willingly remained in and under the water when placed there. He says further: "The conclusion, then, is that instead of two well-marked species or a species and a variety, we have but a single species, *Diemyctylus miniatus*."

Sarah P. Monks ('80), in discussing the differences in opinion concerning these two forms, adds: "I have also observed this change several times,"—*i. e.*, the change from the red to the viridescent form. "I have kept them (the larvæ) till they became terrestrial, and had yellow spots along their olive-green sides; but

they would not eat, and died in about a week. I am very sorry not to have been able to keep any till they reached the red eft stage. Their dying so young makes a break in the chain of observed facts that prove the red eft to be a young form of the spotted salamander. I believe, but am not able to prove at present, that the young *Diemyctylus viridescens* attains its red garb the summer it is hatched, remains that color about a year, then gradually becomes duller as it attains full size."

In 1886 Col. Nicolas Pike ('86) verified the observation that the red ones transform into the viridescent form under certain circumstances, and seems inclined to the belief of Hallowell ('56) and Cope ('59) that changed conditions produce the change in coloration: "I have gradually come to the conclusion that the two are identical. Some years ago I captured quite a number of red ones in the Catskill Mountains, brought them home and kept them in a box with other salamanders where they could resort to water if they chose. For some days they remained hiding under wet moss and stones, but finally crept out at night and went into the water. . . . In about three months they lost their bright red, and in less than a year they were of the usual olive of the *virides-cens*. Another fact, still more decidedly bearing on the case, is that some two-year-old *viridescens* taken from the ponds and put in earth and dead wet leaves in a tub in my garden, without water, in a month or so began to lose their green tint and assume a dingy brownish hue. . . . When the young leave the water the food changes to spiders, insects, earthworms, etc., so totally different from the prey of the ponds, and it is most probable that this is the first cause in the change of color in the little Diemyctylus."

In 1890 Gage and Norris ('90) kept a bright red Diemyctylus, found in the woods, over the winter in a box of leaves and rotten wood with other salamanders. It was of the usual red color in the spring; but when opportunity was offered, it entered the water, and within two weeks had assumed all the characteristics of the viridescent form.

Finally, in the "Batrachia of North America" Prof. Cope thus summarizes the state of knowledge, as it then existed, with refer-

ence to these two forms: "There are two forms of this subspecies, which have received the names of *viridescens* and *miniatus* respectively. These have been shown to be stages of one and the same animal; they are not distinguished otherwise than as seasonal forms, which may be by reason of the environment rendered permanent for a longer or shorter time" (p. 207).

As seen by the above quotations, Say apparently made but a single species of the red and viridescent forms; but some later authors even placed them in different genera. Their great similarity was, however, remarked upon by Storer and others. Finally, since the work of Baird in 1850 they have remained in the same genus, but have been by many considered as distinct species. A further study and more careful observation of living specimens, have, since 1850, indicated the probability, and finally showed the certainty, that the two forms were states of the same species ('56–'90). Furthermore, these observations not only showed that the red, terrestrial form changes to the viridescent, aquatic form, but, where the matter is discussed, it is assumed that the reverse may occur, the difference of coloration, roughness, etc., being dependent upon season, food, and environment (Hallowell, '56; Cope, '59, '87; Pike, '86).

While Say ('19) says the young is of a uniform orange color, the sentence immediately following that statement, "It is decidedly aquatic," leaves one in doubt concerning his actual knowledge concerning the two forms. There is one author, however (Monks, '80), who distinctly intimates, although unable to prove, that the red form is a stage in the development of the Diemyctylus. Both Say and Monks are silent concerning the possibility of a return of the viridescent to the red coloration.

In order to complete the chain in the life-history of the Diemyctylus, and to determine so far as possible its habits, structure, physiology, and transformations during the varying phases of aquatic and terrestrial existence, the writer has availed himself of every opportunity for investigating it during the last six years. The results of this study may, perhaps, best be given by commencing with the egg:

Fertilization and Ovulation.—It has been assumed by most observers that, in analogy with the European tritons, the eggs of Diemyctylus are internally fertilized (Baird, '51; Whitman, '85), It is said to be external by Col. Pike ('86), who supposed that the eggs were laid in masses. So far as I have been able to ascertain, no one has previously undertaken experiments to definitely settle this point. The mode of copulation, if it may be so called, is so different from that described for the European tritons in which internal fertilization has been demonstrated that from it alone one would not expect internal fertilization. The hind legs of the male are exceedingly strong, and have developed on the ends of the toes dark, horny masses, also horny ridges along the inner or opposed surfaces of the legs (Pl. XXIII., Fig. 9). These are mostly absent in the summer. As the animals slowly move about in the water, when the male comes sufficiently near a gravid female, there is a rapid movement of the body to get above her, then the two powerful legs come together like the jaws of a steel trap, grasping the female either just in front or just behind her front legs. The ventral side of the male is thus applied to the dorsal side of the female in the thoracic region, and consequently the cloacal openings are very widely separated. The male keeps his position for an hour or longer, and during part of this time, as Baird ('51) remarks, "jerks the female round in the water most unmercifully." The cloaca of the male is very widely open and pressed against the back of the female, and when not swimming around the tail is waved from side to side. The cloacal papillæ or villi are brought into view by the eversion of the cloaca. They remind one of the cloacal villi or of the gill filaments of a male Necturus. In case the female shakes the male off, as sometimes happens, the cloaca of the male may remain everted, and the tail is waved from side to side while resting on the bottom or on a branch of vegetation. This also occurs when he voluntarily leaves her for the purpose of depositing spermatophores (Zeller, '90; Jordan, '91).

As the egg-laying never takes place during the mating, the eggs must be fertilized after laying by the zoosperms diffused in the water, or the zoosperms must in some way get into the cloaca or

oviduct and fertilize the eggs before they are laid. To determine which of these alternatives was correct a clean jar, holding about two liters of water, was taken, and in the water was placed a pair of Diemyctylus. About half an hour after the mating had ceased the water was filtered through absorbent cotton. Adhering to the upper part of the filter were multitudes of zoosperms. This showed that the zoosperms were emitted into the water. Another clean jar was then taken and partly filled with water from the university water supply, and into it were placed some Anacharis and Ceratophyllum that had been in the laboratory all winter, and not in contact with Diemyctylus. The female was then carefully rinsed in several waters, and finally under the tap, to ensure the removal of zoosperms from the surface. She was then put into the clean jar with the water plants. It was believed that in this way external fertilization would be precluded, and that if eggs were laid and developed it would prove internal fertilization. Commencing the day after isolation, this female laid eight eggs in four days (from the 9th to the 13th of April).

In laying the eggs the female would select a place, usually a well-leaved part of the Anacharis or Ceratophyllum. This was then clasped by the hind legs, and held close to the cloacal prominence. The body showed several writhing or serpentine movements, the legs were pressed somewhat more closely together, and then the female would move away without looking around to see whether or not the egg was securely protected. When first laid the albumen is quite cloudy, but soon clears up; it is also very adhesive, so that when forced in between the leaves it sticks to them and holds them together. It usually took from five to ten minutes to lay an egg. Those observed were laid in the daytime.

In case no green vegetation is present, the eggs are laid on bare stems (Pl. XXIII., Fig. 1) or on stones. The eggs must be laid on stones in nature when no vegetation is present, as occurs in some parts of Cayuga Lake, where they were found mating.

After a few days all but two of the eggs showed signs of development, and embryos in various stages were secured and sec-

tioned. Some were allowed to go on till hatched. This occurred in thirty-three days after the eggs were laid.

After laying the eight eggs no more were laid for over a week. She was then placed with a male for two or three days, when mating again occurred. After mating, she was again isolated as before to see if the ovulation would recommence, and if the eggs would be fertile. Seven days after isolation she commenced to lay eggs, and continued to do so until six or seven were laid. These proved fertile, and several stages of development obtained. This experiment indicates that for a single mating about six eggs may be internally fertilized, about the number found in the two oviducts at one time. It indicates, further, that in nature more than one mating probably occurs (see below); and finally, almost certain proof is given that the eggs are not externally fertilized, as in the last experiment none were laid until seven days after isolation. Three other females were isolated as described above, and the eggs proved fertile.

From these experiments it appears almost certain that the ova are internally fertilized, and as to the way in which the zoosperms reach the eggs, as there is no approach to a true copulation, the explanation of Professor Baird ('51) must be the correct one: "The seminal matter becomes diffused in the water, and fecundates the ova while still in the lower part of the oviduct." Or more probably the spermatophores recently described by Zeller ('90) and Jordan ('91) in some way aid the entrance of the zoosperms more surely than would simple diffusion in the water.

The time of ovulation was found to begin the first week in April in specimens obtained from a spring-fed pond, and to continue in different specimens from this pond till after the first of May. In specimens from Cayuga Lake, June 13th, eggs were obtained until June 18th. Probably in specimens obtained later eggs might have been obtained also. It would appear from this that the ovulating season is much earlier in the inland ponds than in the lake.

Autumnal Mating.—If adult specimens are obtained from their natural habitat in the autumn, the males will be found to possess the dark horny toe-tips and the ridges on the thighs as shown in

Pl. XXIII., Fig. 9; and the tail-fin will be found as fully developed as in April. It has also the wavy appearance as if it were too long for the tail. If the two sexes are placed together a typical mating will occur, and the emission of spermatophores will occur exactly as described for the spring, or proper breeding season (Jordan, '91). Observing the act of emitting the spermatophore and its subsequent examination is greatly facilitated by using a clean glass jar containing very little vegetation. The spermatophore is anchored on the bottom of the glass jar, and has the general appearance of a drinking-goblet,—that is, the attached part is like the broad base of the goblet,—and this is continued into a narrow part, upon the summit of which the oblong sperm-mass or sperm-ball (about 2x4 mm.) is attached, thus occupying the position of the cup part of the goblet, to continue the comparison. At first the sperm-mass is detached from the spermatophore with some difficulty, but later much more easily. If it is transferred to a watch-glass or a slide and examined in water, using preferably dark-ground illumination, the sperm-mass will appear like a mass of white ringlets, there being hundreds of zoosperms in each ringlet. The motion of the zoosperm as a whole, and the active waving of the lateral membrane or frill, is very vigorous. It was found also that isolated males would emit spermatophores, thus making them comparable with the European Triton (Gascoe, '80).

It is not easy to understand the purpose of this autumnal mating, as no eggs were ever found in the oviducts in the autumn, and it is not known that ovulution takes place at other times than in the spring, or breeding season proper. Judging from what has been found concerning European forms, where the eggs laid proved fertile although wintered in the aquarium, and not in contact with the male since its capture, also from the several broods of young from the *Salamanda atra* with but a single fertilization, it appears probable that the zoosperms are stored in some way by the female until the time of ovulation. (See Gascoe, '80; Fatio, '72; Jordan, '91; Czermak, '43; V. Siebold, '58; Zeller, '90.)

So far as I know, the presence of the horny toe-tips and thigh ridges and the prominent tail-fin have been uniformly described

as characteristic of the spring,—that is, the breeding season proper. So also the autumnal mating is, so far as I know, an entirely new observation. It was observed many times by myself, and at two different times independently by Mr. F. B. Maxwell, fellow in zoology and botany in Cornell University.

Habits of the Larvæ and Duration of the Larval Period.—The eggs of the Diemyctylus hatch in from twenty to thirty-five days, depending upon the temperature. From the first the coloration approaches that of the viridescent form; it has also the slim appearance and delicate outlines of the more mature ones. The gills are very prominent at a very early age, and project obliquely over the back. The larvæ are very timid and exceedingly active when they move. Frequently they remain for a considerable time in the clear water of the aquarium, with the beautiful red gills outspread and the body straight as an arrow. If disturbed in any way they dart into the vegetation like a flash. The body is narrow and the head pointed, thus forming a very marked contrast with the broad-headed Amblystoma larvæ. Indeed, they so strikingly resemble the adult viridescent form that it is not difficult to recognize them.

When several different kinds of larvæ are in the same aquarium, they differ from the adult aquatic form, however, in that the tail-fin extends almost to the head as a dorsal crest, something as in *Triton cristatus*.

The food appears to be entirely of an animal nature. Specimens from the ponds where the conditions are entirely normal contained minute Crustacea, larval insects and snails, and in some, aquatic worms were found. The larvæ in the aquarium were kept in food by an occasional addition of water and vegetation from their natural habitat. Early in August, while the gills are still prominent, the characteristic vermilion spots commence to appear, thus giving the larvæ a still more striking resemblance to the adult (Pl. XXIII., Fig. 3). Water is frequently taken into the mouth and passed through the gill openings for respiratory purposes, and the oral epithelium is stratified and non-ciliated, as in Necturus. The œsophagus is lined with ciliated epithelium, but none is present at any time in the stomach, thus further agreeing with

Necturus and differing from the larvæ or tadpoles of the bullfrog (*Rana catesbiana*) (Gage, '85, Gage, S. H. and S. P., '90).

During the last half of August the gills begin to be absorbed and also the tail fin, and the larva more frequently goes to the surface for air. Finally, during the last of August and the first of September, the gills and tail fin being nearly absorbed, the larva keeps its head out of the water an hour at a time, and finally crawls out of the water entirely.

The larvæ do not, apparently, all transform during the first summer, for specimens with gills have been taken from upland ponds in November. The size attained by the larvæ before transforming is quite various. Those observed by me were usually about the size shown in the plate (3 to 4 centimeters long); but they may become much larger. Indeed, they may remain in the branchiate condition till they are as long as some of the adult aquatic ones, and two or three times the length of some of the red ones found in nature. Large branchiate larvæ were obtained for me by Instructor Pierre A. Fish from a fresh-water pond at Wood's Holl, Mass. The tail-fin is small in these large larvæ, and there is no crest extending to the head as in the smaller larvæ. Other unusually large-gilled larvæ will be described by Prof. O. P. Hay in the forthcoming report on "The Batrachians and Reptiles of Indiana," soon to appear in the report of the Geological Survey of Indiana.

Terrestrial Life.—In order to keep the young newts alive and in health, a large glass dish was taken and a considerable amount of moist leaves and rotten wood put into it. This was an attempt to imitate nature as nearly as possible. The young newts did well, and gradually began to assume a reddish brown color on the back instead of the viridescent color (Pl. XXIII., Fig. 4). The belly became orange. In fact, it was passing through an almost exact reversal of the transformation of a red into a viridescent form. Late in September and during the first half of October the appearance was that of a rather dark "red newt.." Specimens of the same size found in nature at about the same date showed the transformation of the coloration even more strikingly, as it was of a lighter red over the whole body.

During the transformation from the gilled aquatic to the gill-less terrestrial state the gill slits grow up, and the stratified, non-ciliated, oral epithelium of the aquatic larva is changed for a ciliated epithelium. The vermilion spots have one or more black pigment blotches bordering them, but there is rarely, if ever, a complete black ring around them as in the larger specimens (Pl. XXIII., Fig. 5). The spots differ in size, shape, and somewhat in arrangement in different specimens; in some the number on the two sidesis different (Pl. XXIII., Figs. 4, 8). The general coloration of the body is almost always lighter on the ventral than on the dorsal portion, and differs greatly in different specimens. In some specimens it is a bright color in which the yellow is very prominent, in others the shade is more red, and in still others it is a dingy reddish brown. As shown in Fig. 7, the area of deeper dorsal red corresponds closely with the area that becomes viridescent in the adult form. As to the seat of the coloration, it is mostly due to the network of branched cells under the epidermis. The cells of the epidermis at the opening of the cutaneous glands—*i. e.*, at the summits of the papillæ or tubercles—sometimes become brownish, and in specimens that have not moulted for some time give a dingy look.

It is a curious fact that in these red forms and in the adult green ones the so-called fat-body is almost invariably of the color of the skin on the ventral portion of the body, and under the microscope shows reddish bodies almost exactly the color of the coloring matter in the chromatophores under the epidermis. The vermilion spots are produced by a deeper or redder coloration of the chromatophores. With the micro-spectroscope no distinctive absorption bands were found.

The food during the terrestrial life consisted of spiders, insects and insect larvæ, and earthworms. The larger red specimens in captivity take earthworms with great readiness. In nature the red ones live in situations, mostly at a considerable distance from water, and as well remarked by Baird ('51), is the most terrestrial of all the American salamanders. It is found under sticks and stones, and especially under rotten logs and in moist woods. It is

very rarely seen wandering around except after a rain, hence it is quite generally believed by non-naturalists to rain down.

Their movements are quite rapid, and very quickly disappear if placed where they can crawl into the grass or among leaves. They will overcome quite prominent obstacles, and in getting down from a considerable height they use the tail as a fifth hand, like a monkey, and can practically support themselves nearly their whole length. The aquatic form also frequently makes use of the tail as a kind of hand in making its way around in the submerged plants. Sometimes they give out a kind of shrill squeak or cry, but this is not very frequent. The adult aquatic ones occasionally emit a similar cry also.

Although I have been unable to keep them in confinement from the egg until their final transformation into the adult viridescent form, I have been able to obtain from a locality where they were especially abundant [1] such a complete series that it is believed that the terrestrial life continues until the autumn of the third or the spring of the fourth year after hatching,—that is, when they are two-and-a-half or three years old.

Transformation into the Adult.—As previously stated, this transformation may take place either in the autumn or the spring, and in either of these times the transformation may take place: (1) while still on dry land; (2) after entering the water.

1. As the red Diemyctylus attains maturity (judging from the generative organs) it gradually assumes a brownish tint, which merges slowly into a viridescent coloration of greater or less intensity in different specimens. This may occur in the autumn without entering the water, but if placed in the water it willingly remains (Kelly, '78). In two specimens under my own observation, kept in a jar containing moist rotten wood, leaves, etc., the change came about the middle of September. One was of an especially brilliant red, but within two weeks

[1] The favorable place mentioned above is Worcester, Otsego Co., N. Y., along one of the headwaters of the Susquehanna River. The specimens were obtained for me by my nephew, Albert Gage. About 12 miles from Ithaca the red form is also exceedingly abundant in and near an upland forest. This forest is not far from marshy places which are sources of small tributaries to the Susquehanna River on the south and Cayuga Lake on the north.

it, as well as its less brilliant companion, had assumed the characteristic coloration of the viridescent form. These two specimens were fed earthworms occasionally and kept in the jar until the following July. There was not the slightest indication during this period of nearly a year of a return to the red coloration, and the epithelium of the mouth remained ciliated. In the middle of July they were placed where they could enter the water, which they did with great readiness, and remained under for a considerable time at first. The time under water increased in length until within two or three days the pharyngeal respiration under water was fully established; and if put with specimens from pond or lake they could not be distinguished either by appearance or behavior. Furthermore, viridescent specimens from the water have been kept in the air for several months, but there was never any indication of a return to the red garb of the immature form. It was found, as shown in the accompanying plate, that some specimens from the water inclined to a brownish green, hence it was found desirable to note carefully the appearance at the beginning of the experiments. These experiments and observations seem to the writer to entirely preclude the notion that the red form owes its coloration to either food, season, or situation; but that it is normal for a given stage of its growth and development. It is believed also that this change of the red to the viridescent form without entering the water accounts for the belief among some naturalists that the adult aquatic forms voluntarily leave the water and become terrestrial.

2. In the observations of Col. Pike ('86) the transformation from the red to the viridescent form took place after entering the water, and apparently took place in the summer or autumn, although he does not state distinctly. In the cases observed by me one specimen was kept over winter in wood humus, and in the spring given opportunity to enter the water. It did so in a short time, and within two weeks had completely transformed. Two other specimens were found in the woods in the early spring; they likewise entered the water after a few days and gradually changed their red for the iridescent coloration, and assumed an aquatic life with the accompanying pharyngeal respiration and

non-ciliated oral epithelium. Observations have not yet been sufficiently numerous or under sufficiently normal conditions to determine how soon after becoming viridescent and entering the water eggs are laid.

Adult.—By the adult is here meant the olive-green or viridescent form (Pl. XXIII., Figs. 8–11). The normal habitat of the adult Diemyctylus is the water. In Ithaca, N. Y., Cayuga Lake, permanent pools in marshes and permanent spring-fed ponds in the higher or upland are favorite homes. The streams running into the lake are liable to sudden freshets, and Diemyctylus is rarely found in them, at least not within a mile or two of the lake valley. Specimens have been taken from the spring-fed ponds at all times of year except the depth of winter. For catching Diemyctylus in situations where the vegetation is abundant the best method has been found to take a strong net with a long handle and make blind sweeps with it in the water. Frequently where there is no sign of animal life, Diemyctylus and other batrachians may be taken in considerable numbers in this way. According to Storer and Holbrook, they may be seen occasionally in winter, swimming with great vigor under ice an inch thick. It is believed from the preceding that after once assuming an aquatic life the adult never leaves the water except on the drying of the ponds or a special scarcity of food. It is further believed from the facts stated above that although the aquatic forms may be kept in moist places out of the water for months, they never revert to a red coloration, and also that the viridescent forms found on land are in the great majority of cases transformed red ones that have not yet entered the water.

The food consists of insect larvæ, like caddis worms, adult insects, various aquatic worms, earthworms, small Crustacea, bivalve, and univalve mollusks. In captivity they learn to take bits of meat from a stick, to catch flies thrown on the water, and to catch tadpoles. It is quite possible that they indulge in this last mark of affection to their relatives in nature also. When catching tadpoles or other living prey the process is something as follows: The Diemyctylus moves slowly within reach of the prey, and remains perfectly quiet until the prey moves, when it is

snapped up quick as a wink, and it is rare that a failure is made. A tadpole is also liable to be caught if it attempts to swim by the Diemyctylus. In taking earthworms on land there is an attitude of the body and curve of the neck strikingly like the restorations of some of the ancient saurians seen in works on paleontology.

Moulting.—Both the red and the viridescent forms shed the skin at various times throughout the year. There seems to be no regular time, as in June, mentioned by some authors. In the terrestrial form the exuvium is liable to be much torn, but frequently I have seen in Cayuga Lake perfect specimens floating in the water, and appearing, as one might imagine, like the ghosts of their former owners. I have never seen the cast skin rolled up and swallowed by the aquatic form; but the terrestrial ones pull the exuvium off the tail with the mouth and afterwards swallow it.

Respiration and Relations to Oral Epithelium.—In the beginning of larval life the respiration is wholly aquatic; then, as the lungs become developed, it gradually changes to a mixed or combined respiration,—*i. e.*, to a respiration partly aërial and partly aquatic. Later, when the larva leaves the water and becomes terrestrial, the respiration becomes wholly aërial. Upon transforming to the viridescent form, and reëntering the water, the respiration again becomes mixed.

If one observes a terrestrial Diemyctylus carefully the floor o the mouth and pharynx will be seen to sink and rise alternately, and many times per minute. The appearance in pharyngeal inspiration may be seen in Fig. 10; in expiration, in Figs. 7 and 11. The same pharyngeal movements may be seen in a frog or turtle On entering the water the Diemyctylus remains under for a considerable time, and during its submergence the same rhythmical pharyngeal movements occur, and water instead of air is alternately taken into the mouth and expelled, as in the soft-shelled turtles; and, as in the soft-shelled turtles, it is believed that it is for respiratory purposes (Gage, S. H. and S. P., '85). It is further believed, from chemical analyses, and from experiments made with the respiration of tadpoles and with Ganoid fishes, that whenever respiration is thus mixed or combined "the aërial part

is principally to furnish oxygen and the aquatic part to eliminate carbon dioxide" (Wilder, '77; Gage, S. H. and S. P., '85, '86, '88; Mark, '90).

It has been found in every one of a great many cases that whenever the respiration is wholly aërial, the entire mouth cavity is lined with ciliated epithelium which is directly continuous with the ciliated epithelium of the œsophagus. This is found not only in the red forms and the viridescent forms that had not yet entered the water, but when an aquatic form was kept in the air for ten days or two weeks the epithelium of the mouth was likewise found to be ciliated like that of the proper aërial forms. This was verified on several specimens and direct comparisons made with specimens from the same aquarium.

The branchiate larvæ and the adult aquatic forms have an oral epithelium of non-ciliated cells, as in Necturus and Cryptobranchus. It is astonishing to see how quickly a Diemyctylus with purely aërial respiration and ciliated oral epithelium will assume a partially aquatic or mixed respiration and the ciliated epithelium of the mouth become non-ciliated. The change has something of the character and certainty of a simple chemical reaction, and appears to show the direct relation of the mode of respiration to the character of the oral epithelium.[2]

[2] To determine whether or not the mouth has a lining of ciliated epithelium, the animal is pithed and the slit of the mouth is continued along the body beyond the stomach. The floor of the mouth is turned over and the œsophagus slit into the stomach. In this way the mucosa from the tip of the snout to and into the stomach is freely exposed. Then minute blood-clots—a method first devised by Mrs. Gage, so far as I know—are placed on the mucosa at various points. Care is taken that there shall be no drying of the membrane by keeping it well moistened with blood serum or spittle. In this way it is exceedingly easy to determine whether or not there is a complete lining of ciliated epithelium, for the ciliary currents quickly sweep the blood-clots toward and finally into the stomach. It is also an excellent method for discovering small ciliated areas. In addition to this, careful microscopic examinations were made of the epithelium from various parts of the mouth. This, of course, had to be the method employed in determining the character of the oral epithelium at the beginning of an experiment with living specimens. In the scrapings from the mouth of an aquatic Diemyctylus a few ciliated cells may be found under the microscope, but in such specimens there were no demonstrable ciliary currents. The source of the few cells is thought to be from the opening of the glottis or from the ciliated lining of the mouths of the buccal glands.

Conclusions.—So far as I have yet been able to learn from the opinions of others or my own observations, no explanation has offered itself for the bright color of the terrestrial, red form. The color renders it exceedingly conspicuous, and there is no counter-balancing compensation in sexual selection, for the red form is sexually immature. The olive-green or viridescent color of the adult does render it inconspicuous in green terrestrial or aquatic vegetation; they are sometimes found in large numbers in water nearly devoid of vegetation, however.

With reference to the change from the aquatic to the terrestrial life, and later the return to an aquatic life, there is perhaps a more satisfactory explanation or hint. Diemyctylus conforms in habits with the vast majority of batrachians in going to the water to lay its eggs. Still conforming to the habits of the group, the larvæ, on reaching a certain stage of development, absorb their gills, leave the water, and become air-breathers. It is not the purpose of this paper to attempt a discussion of the causes which led, in the course of evolution, to the assumption of an aërial for an aquatic existence by the Diemyctylus and many other Batrachia. It must be assumed that the reasons were sufficiently potent. Two will occur to every one conversant with the breeding places of the batrachians,—the danger of the drying of the water, and the limited amount of food.

With but few exceptions, the preparation for reproduction requires the terrestrial forms to again enter the water, and the life becomes for a greater or less time once more partially aquatic. A partial return to an aquatic mode of respiration, and the taking in of water by the pharyngeal movements described above, is by no means restricted to Diemyctylus, but it may be seen in such highly terrestrial forms as the little brown tree-toad (*Hyla pickeringii*) and the yellow-spotted salamander (*Amblystoma punctatum*). It appears as if the surroundings of larval life, and the necessity for respiration brought about by the prolonged stay under water required for fertilization and ovulation recalled by a kind of organic memory the mode by which respiration was accomplished in larval life.

In Diemyctylus this mixed respiration and the food supply apparently proved so satisfactory that the aquatic life again became fixed, and, acting through numberless generations, the tendency to revert to aquatic life became so great that maturing forms sometimes enter the water at least six months before the breeding season (Kelly, '78). It does not, however, revert so completely to an aquatic life that it cannot, in case of necessity, again become terrestrial for a considerable time.

This permanent reversion to a primitive mode of life by Diemyctylus does not stand alone among the Batrachia. It is paralleled and even exceeded by Siren, which after passing through the ordinary larval metamorphosis, has its gills so far absorbed as to be mere stubs. It then not only returns to the water, but actually reacquires its gills (Cope, '85). These two cases seem to point to the conclusion that in the course of evolution the dangers and hardships of the land became equal or greater than those of the water for these forms, and they, by readjusting themselves to an aquatic life, rendered the struggle for existence less severe. Certainly there is no reason, in the fundamental idea of evolution, why an animal may not revert to an earlier condition, provided it becomes as markedly to its advantage as was the original departure from that condition.

Summary.—1. The red and the viridescent forms of Diemyctylus belong to the same species, the red form being an immature condition.

2. The ova of Diemyctylus are internally fertilized, and are laid singly on a submerged leaf, or between submerged leaves, and partly concealed by folding the leaves closely together. If no leaves are available, the eggs are laid on stones or bare stems. The eggs hatch in about thirty days.

3. In from three to four months after hatching, vermilion spots appear, and are symmetrically arranged along the dorsal aspect next the head. The general appearance is then strikingly like that of the adult male in the breeding season, except that the tail crest, instead of ending opposite the pelvis, extends nearly or quite to the head, as in the crested Triton. Later, gills and tail-fin atrophy, and the respiration becomes more and more aërial.

4. After the gills are absorbed the animal leaves the water, and the color gradually changes from an olive-green to brownish-red, and finally, during the same season, assumes a bright yellowish-red, the vermilion spots remaining and becoming partly surrounded by black pigment.

5. As the terrestrial life is assumed the stratified, non-ciliated oral epithelium of the aquatic larva gradually changes to a ciliated epithelium continuous with that of the œsophagus.

6. In the autumn of the third or the spring of the fourth year after hatching (when two and one-half or three years old), the red changes for a viridescent coloration. This may occur with or without entering the water. If the water is entered the animal changes to an aquatic mode of life.

7. On reassuming an aquatic life the ciliated, oral epithelium becomes again stratified and non-ciliated, as in the aquatic larva, and as in Necturus and Cryptobranchus.

8. After becoming adult and transforming to the viridescent coloration, the Diemyctylus always remains of that general color, and never again becomes red, even when kept out of water a whole year, thus showing that the coloration is dependent neither on food, season, nor environment, but is normal for a given period of life only.

9. The adult viridescent forms are purely aquatic under favorable conditions, and after once entering the water do not leave it, although they are able to live for several months, and perhaps indefinitely in moist places, wholly out of water. Rhythmical pharyngeal respiration is very marked both in air and under water.

10. The character of the oral epithelium seems directly dependent on the mode of respiration, being stratified and non-ciliated with a purely aquatic or a mixed respiration, and ciliated with a purely aërial respiration.

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BLANCHARD, R.—'81. Sur les glandes cloacale et pelvienne et sur la papille cloacale des Batraciens urodeles. *Zool. Anz.*,Bd. IV. (1881) pp. 9, 34. Believes that the cloacle glands of the male and female are homologous, and that it was the cloacle gland that v. Siebold described as a receptaculum seminis. See Jordan, '91, p. 266.

BOULANGER, G. A.—'82. Catalogue of the Batrachia Gradientia s. Caudata, and Batrachia Apoda in the Collection of the British Museum. Second edition, London, 1882. Red and viridescent forms not distinguished as different species.

BRAUN, DR. M.—'78. Ueber äussere Hülfsorgane bei der Begattung von *Triton* (*Diemyctylus*) *viridescens*. *Zool. Anz.*, Bd. I., 1878, pp. 124–126. Describes the so often and previously described horny ridges on the opposing surfaces of the hind legs of the male in the breeding season. See Baird, '51 ; Cope, '66, '87.

COPE, E. D.—'59. On the Primary Divisions of the Salamandridæ, with Descriptions of Two New Species. Proc. Acad. Nat. Sci., Philada., Vol. II. (1859), pp. 122–128. Expresses the belief that the red and viridescent forms are states of the same species.

COPE, E. D.—'66. On the structure and distribution of the genera of the Aciferous Anura. Phila. Acad. Nat. Sci. Jour., Vol. VI. (1866–1869), pp. 65-112.

'85. The Retrograde Metamorphosis of Siren. AMERICAN NATURALIST, Vol. XIX. (1885), pp. 1226, 1227, also p. 245. Describes atrophy of external gills in the young and their subsequent redevelopment,

'87. The Batrachia of North America, Bulletin of the U. S. National Museum, No. 34. Letter of transmittal, February, 1887, published 1889. There is given the life-history so far as was known, as well as the zoological position of the different American forms.

Claus, C.—'82. Grundzüge der Zoologie. Marburg, 1882. In Vol. II., pp. 256, 257 are given notes on breeding habits of European Tritons.

Claus, C., and Sedgwick, A.—'84. Elementary Text-Book of Zoology. London, 1884. In Vol. II. are given notes on the breeding habits of European salamanders.

Czermak, J. J.—'43. Beitrage zur Anat. und Physiol. des schwar zen Salamanders, in den med. Jahrb. des österr. Staates. Bd. XLV., 1843, p. 8. V. Siebold and Zer ('58, p. 472) and Czermak show that *Salamandra atra* may bring forth more than one brood for a single fertilization.

De Kay, J. E.—'42. Natural History of New York. Zoology; Part III., Reptiles and Amphibia. Albany, 1842. Describes red form as two species (*Salamandra coccinea*, p. 81, and as *S. symmetrica*, p. 73), and puts the viridescent form in a different genus (*Triton millepunctatus*. See synonymy.

Dumeril et Bibron.—'41. Erpétologie Génèrele Complète des Reptiles. Tome VIII., Paris, 1841. See synonymy.

Fatio, V.—'72. Faune des vertebres de la Suisse. Vol. III., p. 454 Geneve et Bale, 1872. States that Triton of Europe may give off spermatophores when isolated.

Gage, S. H.—'85. The Epithelium in the Mouth of Necturus and Menopoma (Cryptobranchus). Proc. Amer. Soc. Microscopists, 1885, pp. 126, 127; the *Microscope*, Vol. V. (1885), pp. 210, 211. It is shown that the epithelium in the mouth of these two animals is stratified and non-ciliated.

'90. Combined Aërial and Aquatic Respiration in Amphibia, and the Function of the External Gills in Salamanders Hatched on Land. Proc. Amer. Asso. Adv. Sci., Vol. XXXIX. (1890), p. 337. See generalization in '86, '88.

Gage, S. H. and Gage, Susanna P.—'85. A Contribution to the Physiology of Respiration in Vertebrates. Proc. Amer. Asso. Adv. Sci., Vol. XXXIV. (1885), pp. 316–318; American Naturalist (1886), pp. 233–236; *Science*, Vol. VI. (1885), p. 225; *Scientific American* supplement, Nov. 14th, (1885), p. 8230; *Biologisches Centralblatt*, Bd. IV. (1886–'87), pp. 213, 214. It is shown in this paper that the soft-shelled turtles (Amyda and Aspinodectes) have a mixed or combined Aërial and Aquatic respiration, and that the carbon dioxide is largely given off to the water, while the oxygen is largely derived from the air.

'86. Pharyngeal Respiratory Movements of Adult Amphibia Under Water. *Science*, Vol. VII. (1886), p. 395. Report of the discovery that in Diemyctylus there is a rythmical filling and emptying of the pharynx while under water as in soft-shelled turtles.

'86 and '88. Combined Aërial and Aquatic Respiration. *Science*, Vol. VII. (1886), p. 394; and in the Reference Hand-Book of the Medical Sciences, Vol. VI. (1888), p. 197. The generalization is made that in case of combined aërial and aquatic respiration "the aërial part is mainly to supply oxygen, and the aquatic part to get rid of carbon dioxide." See also Wilder, '76, and Mark, '90.

'90. Changes in the Ciliated Areas of the Alimentary Canal of the Amphibia during Development, and the Relation to the Mode of Respiration. Proc. Amer. Assoc. Adv. Sci., Vol. XXXIX., pp. 337, 338. It is shown that while the respiration is mostly aquatic in tadpoles, the oral epithelium is non-ciliated, but gradually becomes ciliated as aërial respiration is acquired.

GAGE, S. H., and NORRIS, H. W.—'90. Notes on the Amphibia of Ithaca. Proc. Amer. Assoc. Adv. Sci., Vol. XXXIX. (1890), pp. 338, 339. A red Diemyctylus was kept through the winter in moist wood humus; in the spring it entered the water and soon changed to the viridescent form.

GASCO, F.—'80, and '81. Les Amours des Axolotles. *Zool. Anz.*, IV. (1881), pp. 313, 334; Bull. Soc. Zool. Fr. (1881), pp. 151–162. Describes fertilization and ovulation of Axolotles. See also Gli amori del tritone alpestre, Geneva, 1880.

HALLOWELL, EDWARD.—'56. Description of Several Species of Urodeal, with Remarks on the Distribution of the Caducibranchiate Division of these Animals and their Classification. Proc. Acad. Nat. Sci., Philadelphia, Vol. VIII. (1856), pp. 6–11. In a note to page 11 expresses the belief that the red form is the same as the viridescent Diemyctylus; the difference in appearance being due to the difference in situation, in analogy with the change in appearance of the European Tritons when they pass from an aquatic to an aerial life.

HARLAN, R.—'25. Description of the *Coluber fulvus* Linn., a New Species of Scincus and Two New Species of Salamandra. Jour. Acad. Nat. Sci., Philadelphia, Vol. V. (1825), pp. 154–158. See synonymy.

'27. Description of a New Species of Salamandra. Jour. Acad. Nat. Sci., Philadelphia, Vol. VI. (1827), p. 101. See synonymy.

HAY, O. P.—'89. Notes on the Habits of Some Amblystomas. AMERICAN NATURALIST, Vol. XXIII. (1889, pp. 602–612. Gives notes on ovulation, food, respiration, etc. See also his paper on the "Batrachians and Reptiles of Indiana" in the forthcoming report of the geological survey of the state.

HOFFMAN, C. K.—'73–'78. Klassen und Ordnungen der Amphibien. VI. Bd., II. Abtheilung, in Dr. H. G. Bronn's Klassen und Ordnungen des Thierreichs. Leipzig und Heidelberg, 1873–1878. Gives anatomy, classification, and development. Good bibliography.

HOLBROOK, J. E.—'42. North American Herpetology, Vol. V. Philadelphia, 1842. First edition, 1838. Figures and describes *Diemyctylus viri-*

descens, and expresses the belief that it never voluntarily leaves the water; frequently observed it swimming with great vivacity under ice an inch thick.

IWAKAWA, T.—'82. The Genesis of the Egg in Triton. *Quart. Jour. Micr. Sci.*, Vol. XX. (1882), pp. 260–277. Believes fertilization of this Japanese Triton to be internal as zoosperms found in the oviduct. Female turns upside down in ovulating.

JORDAN, D. S.—'80. Manual of the Vertebrates of the Northern United States, Exclusive of Marine Species. Third revised edition, Chicago, 1880. Makes two species of the two forms, but states that they have the same range and the red form may be a variety or a state of the *viridescens*.

JORDAN, E. O.—'91. The Spermatophores of Diemyctylus. *Journal of Morphology*, Vol. V., pp. 263-270. Gives an excellent account of the mating and the spermatophores as seen in the spring. Found zoosperms in the ducts of the cloacle glands of the female.

KELLEY, H. A.—'78. Identity of *Diemyctylus miniatus* with *D. viridescens*. AMER. NATURALIST, Vol. XII. (1878), p. 399. Red Diemyctylus obtained in the summer changed gradually to the viridescent form in the autumn without entering the water, but willingly remained in the water when there placed.

KNAUER, FR. K.—'78. Naturgeschichte der Lurche (*Amphibiologie*). Wien, 1878.

LATASTE, F.—'78, '81. L'accouplement chez les Batrachian Urodèles. Revue Internatl. d'Science, 1878, pp. 209–214, 488–499; 1881, pp. 154–164. As the title indicates, the fertilization of the eggs in Urodeles is discussed.

MARK, E. L.—'90. Studies on Lepidosteus. Part I. Bulletin of the Museum of Comparative Zoology at Harvard College, Vol. XIX., No. 1 (1890). Arrives at the same general conclusion regarding combined aërial and aquatic respiration as that given by S. H. and S. P. Gage ('85, '86, '88).

MILNE-EDWARDS, H.—'63. Leçons sur la Physiologie et l'Anatomie Comparée de l'Homme et des Animaux. Tome 8, Paris, 1863. Describes structure, fertilization, and ovulation in Urodeles living in Europé.

MONKS, SARAH P.—'80. The Spotted Salamander. AMER. NATURALIST, Vol. XIV. (1880), pp. 371–374. Excellent account of the habits, etc., of Diemyctylus. Observed the change from the red to the viridescent form; believed, but unable to prove, that the red form was a *young stage* of the viridescent.

OWEN, RICHARD.—'66. On the Anatomy of Vertebrates. Vol. I., Fishes and Reptiles.

PFITZNER, W.—'80. Die Epidermis der Amphibien. I., Untersuchungen über Bau und Entwicklung der Epidermis des geflecten Salamanders. *Morph. Jahrb.*, Bd. VI., (1880), pp. 469–526. Discusses the seat of color in the skin of salamanders and the breeding habits of the Salamandra.

PIKE, COL. NICOLAS.—'86. Some Notes on the Life-History of the Common Newt (*Diemyctylus miniatus viridescens*), AMER. NATURALIST, Vol. XX. (1886), pp. 17–25. Observed change of red to viridescent form; believes that the adults leave the water after the breeding season is over, that the eggs are in masses and are externally fertilized. Many excellent notes on food, habits, etc.

RAFINESQUE, C. S.—'20. In Annals of Nature, or Annual Synopsis of New Genera of Plants, Animals, etc., Discovered in North America, by C. S. Rafinesque, Transylvania University, Lexington, Kentucky. 1820. Nos. 22 and 24. See synonymy and quotations.

ROBIN, CH.—'74. Observationes sur la Fécondation des Urodèles. Journal de l'Anatomie et de la Physiologie Normale et Pathologique de l'Homme et des Animaux. Tome X. (1874), pp. 376–390. *Ann. and Mag. Nat. Hist.*, Vol. XIV. (1874), p. 96. Excellent general discussion with specific example.

RUSCONI.—'21 and '54. Amours des Salamandres Aquatiques. Milano, 1821. And Histoire Naturelle, Développment et Métamorphose de la Salamandre Terrestre. Paris, 1854.

SAY, THOMAS.—'19. Notes on Herpetology. *American Journal of Science*, Vol. I., pp. 256–265. Diemyctylus on pp. 264–265. He apparently put both forms in the same species. See quotation in text above.

SIEBOLD, V.—'58. Ueber das Receptaculum Seminis der Weiblichen Urodelen. *Zeitschr. für wiss. Zool.*, Bd. IX (1858), p. 463.

SPALLANZANI, L.—1785. Expériences pour servir à l'histoire de la génération des animaux et des plantes; avec une ébauche de l'histoire des êtres organisés avant leur fécondation. Par J. Senebier. Genève, 1785, pp. 53, 97, 141. Spallanzani showed that in several European aquatic salamanders the eggs are internally fertilized; and as there was no direct contact of the cloacæ in the sexes he supposed the zoosperms became diffuse in the water and ultimately found their way into the cloaca and oviducts of the female.

STORER, D. H.—'38, '39. Report on the Reptiles of Mass. *Boston Journal of Nat. Hist.* Vol. III. (1838), Batrachia, 40–64; Mass. Reports on the Fishes, Reptiles, and Birds. Boston, 1839. Makes different species of two forms, but remarks on their great likeness. Good account of habits.

STRAUCH, ALEX.—'70. Revision der Salamandriden-Gattungen, nebst Beschreibung einigen neuen oder wenigér bekannten Arten dieser Familie. Mémoires de l'Academie Imp. des Sciences à St. Pétersb., t. XVI., No. 4. See synonymy.

VERRILL, A. E.—'63. Catalogue of the Reptiles and Batrachians Found in the Vicinity of Norway, Oxford County, Me. Proc. Boston Soc. Nat. Hist., Vol. IX., 1862–'63, pp. 195–199. Gives red and viridescent forms as distinct species without remark.

'78. Breeding Habits of Salamanders and Frogs. AMER. NATURALIST, Vol. XII. (1878), pp. 399, 400. Says the eggs of Diemyctylus are in bunches.

WHITMAN, C. O.—'85. Methods of Research in Microscopical Anatomy and Embryology. Boston, 1885. Describes ovulation of Diemyctylus, and expresses the belief that the fertilization is internal (p. 156).

WILDER, BURT G.—'76. On the Respiration of Amia. Proc. Amer. Asso. Adv. Sci., Vol. XXVI. (1876), pp. 306–313. "The normal breath contains rather more than one per cent. of carbonic acid; but much more of the oxygen has disappeared than can be accounted for by that amount of acid. We may infer that with Amia the (carbonic acid) gas is partly excreted by the gills." See Mark ('90), and Gage, S. H. and S. P. ('85, '86, '88).

ZELLER, E.—'90 and '91. Ueber die Befruchtung bei den Urodelen. Zeitschrift für wissenschaftliche Zoologie, Bd. 49, 1890. Gives an excellent account of the history of knowledge concerning the fertilization of European salamanders, and describes anew and more fully that of several. The spring spermatophores of Diemyctylus are also described, and apparently for the first time. In Bd. 51 (1891), p. 735, some corrections are made of the first paper and he concludes that the zoosperms pass from spermatophore by their own activity into the cloaca of the female, and are not taken into the cloaca in any active way by her.

Besides the above, general and specific information may be obtained concerning batrachians in the American Cyclopædia; the Encyclopædia Britannica; the Dictionnaire Universel d'Histoire Naturelle, by Ch. D'Orbigny; in Wood's Natural History, and in the Standard Natural History by Kingsley; in Brehm's Thierleben, second edition.

EXPLANATION OF PLATE. (FRONTISPIECE.)

Transformation of *Diemyctylus viridescens.* Drawn from photographs and colored from nature by Mrs. Gage. All are natural size, except Fig. 2 and the vermilion spot, Fig. 5.

FIG. 1.—Branch of Ceratophyllum with Diemyctylus eggs between the needle-like divisions of the leaves; also nearly bare stem of Anacharis with egg attached.

FIG. 2.—Diemyctylus egg, in the yolk-plug stage of development, attached to an Anacharis leaf. It was from an isolated female, and the parchment-like envelope is ovoid. Outlined with an Abbé camera lucida, and magnified about seven diameters.

FIG. 3.—Dorsal, ventral, and lateral views of a larval Diemyctylus in August and September. The gills are considerably atrophied, and the coloration and vermilion spots resemble the adult.

FIG. 4.—Dorsal and ventral view of a larval Diemyctylus the last of September and first of October, after it has become entirely terrestrial and was gradually assuming a bright red color.

FIG. 5.—Enlarged vermilion spot with complete black ring.

FIG. 6.—Ventral view of a red Diemyctylus taken in the spring, and either two or three years old. This light yellowish-red color is very common. The enlarged vermilion spot (Fig. 5) is to show that in animals of this size and in the adult the vermilion spots are usually entirely surrounded by a black pigment ring.

FIG. 7.—Lateral view of a red Diemyctylus, to show the difference in coloration of the dorsal and ventral portions of the body. By comparing with the viridescent forms it will be seen that the deeper coloration corresponds in situation in the two. The darker red shown in this figure is perhaps more common than the color in Fig. 6.

FIGS. 8, 9, and 10.—Views of an adult male Diemyctylus in October. It was in this specimen that pharyngeal respiration under water was first noticed, in 1886. The color varies considerably, some being darker and some lighter than here shown.

FIG. 8.—Dorsal view. The number of vermilion spots is seen to be few and to differ on the two sides. As shown by the different figures on this plate, the number of vermilion spots varies considerably.

FIG. 9.—Ventral view, showing the dark, horny thickenings on the tips of the toes, and the ridges (commonly six) on the inner or opposing surfaces of the legs. These horny developments mostly disappear during the summer, immediately after the breeding season, and reappear in the autumn.

FIG. 10.—Lateral view, showing the tail-crest or fin, extending on the dorsal side to about opposite the pelvis,—not to the head, as in the European Tritons. This fin is less marked in the female (see Fig. 12), and partly disappears after the breeding season. The cloaca is partly everted, and shows some of the lining fringes or villi. The floor of the mouth and pharynx are depressed as when filled with water or air in pharyngeal respiration. Compare Fig. 11.

FIG. 11.—Lateral aspect of a gravid female. This coloration is frequent in adult forms found in water. The hind legs and the tail fin are smaller than in the male. The pharynx and floor of the mouth are raised as in expiration,—*i. e.*, when the air or water is entirely expelled.

EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

ENDOWMENTS for the support of original scientific research are becoming more frequent in this country. Mr. Thomas Hodgkin, of Long Island, has presented the Smithsonian Institution the sum of $200,000, a part of which is to be devoted to investigations on the characteristics of the earth's atmosphere. He "reserves the right" to add $100,000 to the original amount. The new Rockefeller University of Chicago is to have a large endowment from Mr. Rockefeller for original research. A bequest was made by the late William B. Ogden, of New York, for the purpose of endowing a school of scientific research. The sum, which is between three and five hundred thousand dollars, has been offered by the executors to the same Chicago University, and has been accepted by them. The Philadelphia Academy of Natural Sciences has been the recipient of several bequests within a few years whose aggregate is considerable.

These accessions of strength for scientific research are gratifying, and the manner in which the moneys are expended will be watched with solicitude. The administrators of money are frequently not acquainted with the actual needs of practical research, and their first impulse usually is to erect expensive buildings. The amount of money thus expended frequently cripples the working power of the institution. An undue proportion is sometimes spent on media of publication, of which already many exist in this and other countries. The real need of original research is the endowment of tenable positions for men. This proposition is self-evident, but it has been, nevertheless, too much neglected. But should this liberal course be adopted by such institutions, the question of the appointments to be made at once presents itself. Boards of trustees, being rarely occupied with scientific research, are not generally well informed as to the merits of investigators. It is sometimes difficult to obtain unbiased information even from investigators themselves, who are frequently more or less influ-

enced by personal considerations, rather than by absolute merit. One criterion may, however, be safely trusted as a guide in this difficult question. Let appointees always be selected on account of work actually done. In this way, and in this way only, can the actual merits of a candidate be ascertained. Moreover, let this work have been extended over several years, and not be measured by a graduating thesis or an essay or two. It is never safe to appoint men on the strength of what they are going to do. When rewards are conferred before services are rendered, the services are sometimes never performed. Especially should trustees be careful to distinguish between original investigators and the various kinds of middle men that are so useful in other capacities. Such are teachers, popular lecturers, and compilers of general or popular books; very valuable persons, but not the proper recipients of any part of moneys left for the endowment of original research.

From the same point of view the administration of the affairs of our academies of science, which are media of original research, becomes important. The custom, very general in this country, of electing to membership any person who is willing to pay the entrance fee, must necessarily have bad practical results, in the directions above referred to as incidental to a board of non-scientific trustees. Special scientific knowledge is required for the administration of museums, publications, etc., and these have too often fallen into the hands of totally incompetent persons. It is to be hoped that with the increase in the endowments of our academies of science the necessity of electing members for financial reasons will disappear, and that the membership will eventually be more appropriate to the objects for which such institutions are created.

—WE learn that the committee of entertainment of the Washington meeting of the American Association for the Advancement of Science had a surplus over expenses of about one thousand dollars. We have already referred (NATURALIST, 1891, p. 939) to some economical features of the management by this committee, and we are now presented with another illustration of

their thriftiness. In a circular recently issued the committee recommends that the surplus be presented to the Cosmos Club of Washington, for the purpose of endowing a library. We shall be surprised if the Cosmos Club adopts this suggestion, although the same gentlemen are members of both. As the money was subscribed for the American Association for the Advancement of Science, and as the surplus was obtained by requiring the members to pay their own expenses on the excursions, it would seem that the association is the proper recipient of the money. It would no doubt be very welcome for any one of several objects.

—THE dates of issue of the numbers of the NATURALIST for 1891 are as follows: January, February 21st; February, April 2d; March, April 25th; April, May 23d; May, May 28th; June, June 27th; July, July 31st; August, September 11th; September, October 6th; October, October 23d; November, November 17th; December, December 22d.

RECENT BOOK AND PAMPHLETS.

AMEGHINO, F.—Monte Hermoso, Articulo publicado en La Nacion del 10 de Marzo de 1887.

——Contribucion al Conocimiento de los Mamiferos fosiles de la Republica Argentina, with Atlas. Actas de la Acad. Nac. de Ciencias de la Rep. Argentina en Cordoba. Buenos Aires, 1889.

AMMON, L. VON.—Die permischen Amphibien der Rheinpfalz. From the author.

Association of American Anatomists. History, Constitution, Membership, and the Titles and Abstracts of Papers, for the years 1888, 1889, 1890.

BEECHER, C. E. and J. M. CLARKE.—The Development of Some Silurian Brachiopoda. Memoirs New York State Museum, Vol. I., No. I., 1889. From C. E. Beecher.

BODINGTON, A.—Studies in Evolution and Biology. London: Elliot Stock. From the author.

CADY, A. C.—The American Continent and Its Inhabitants before Columbus. From the publishers, Gebbie & Co., Philadelphia.

CALDERON, S.—Sur les Modifications des roches de Moron (province de Séville). From the author.

CAPELLINI, G.—Sul Coccodrilliano Garialoide. Reale Accademia dei Lincei, 1889.

——Sulla *Balena etrusca*. Estratta delle Memoire dell' Accademia delle Scienze dell' Instituto di Bologna, Tomo III., Serie III.—Del *Tursiops cortesii* e del delfino fossile di Mombercelli nell' Astigiano. Do., Serie IV.—Delfinorinco fossile dei Dintorni di Sassari. Do., Tomo VIII., Serie IV.—Resti Fossili di Dioplodon e Mesoplodon. Do.,

Tomo VI., Serie IV.—*Ichthyosaurus campylodon* e Tronchi di Cicadee nelle Argille Scagliose dell' Emilia. Do., Tomo X., Serie IV.—Sopra Resti di un Sirenio fossile (*Metaxytherium lovisati* Cap.) raccolti a Nivute Fiocca presso Sassari in Sardegna. Do., Tomo VII., Serie IV. Del Zifioide fossile (*Choneziphius planirostris*) scoperto nelle sabbie plioceniche di Fangonero presso Siena. Serie 4.—Memoire della Classe di scienze fisiche, matematiche e naturali, Vol. I. From the author.

Census Bulletin, 1890. From the Dept. of Interior.

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COPE, E. D.—On Vertebrata from the Tertiary and Cretaceous Rocks of the Northwest Territory. Contributions to Canadian Paleontology, Vol. III. From the Canadian Geol. Survey.

DALL, W. H.—Contributions to the Tertiary Fauna of Florida. Trans. Wagner Free Inst. Sc., Vol. III., 1890. From the Institute.

DAMES, W.—*Anarosaurus pumilio.* Besonderer-Abdruck aus der Zeitschrift der Deutschen geologischen Gesellschaft, Jahrgang 1890. From the author.

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EASTMAN, J. R.—The Progress of Meteoric Astronomy in America. Ext. Phil. Soc. Wash., Vol. XI., pp. 275-358. From the author.

EIMER, C. H. T.—Der Deutschen Litteratur-zeitung, Januar, Juli, 1890.

FELIX, J. und H. LENK —Beitraege zur Geologie und Paleontologie der Republik Mexico. Separat-Abdruck aus Paleontographica. Band XXXVII., 1891. From Dr. J. Felix.

FERNOW, B. E.—Tracts on Tree Topics. From the author.

FEWKES, J. W.—A *Journal of Ethnology and Archeology.* Vol. I. From the editor.

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GANONG, W. F.—Southern Invertebrates on the Shores of Acadia. Ext. Trans. Roy. Soc. Canada, Sect. IV., 1890. From the author.

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GEINITZ, H. B.—Ueber einige Lycopodiaceen aus der Steinkohlenformation.—Die Graptolithen des K. Mineralogischen Museums in Dresden. Mittheilungen aus dem Koeniglichen Min.-Geol. und Prae-Hist. Mus. Dresden, 1890. From the author.

GOODE, G. B.—The Origin of the National Scientific and Educational Institutions of the United States. Reprint Papers of the Am. Hist. Ass. From the author.

HARRIS, W. C.—The Fishes of North America. From the author.

JACKSON, R. T.—Phylogeny of the Pelecypoda, the Aviculidæ, and Their Allies. With Plates XXIII.-XXX. Memoirs Boston Soc. Nat. Hist., Vol. IV., No. 8. From the author.

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RECENT LITERATURE.

Flower and Lydekker's Mammals.[1]—In this work we have the result of the combined knowledge of two of the most competent specialists in the field of mammalogy of the present time; and as is to be expected, it is a book of the greatest utility to the student. It is based on the article written by Prof. Flower for the "Encyclopædia Britannica," and has been brought up to date, with the addition of references to the paleontology, by Dr. Lydekker. The former part of the subject is more fully treated than the latter, which is simply

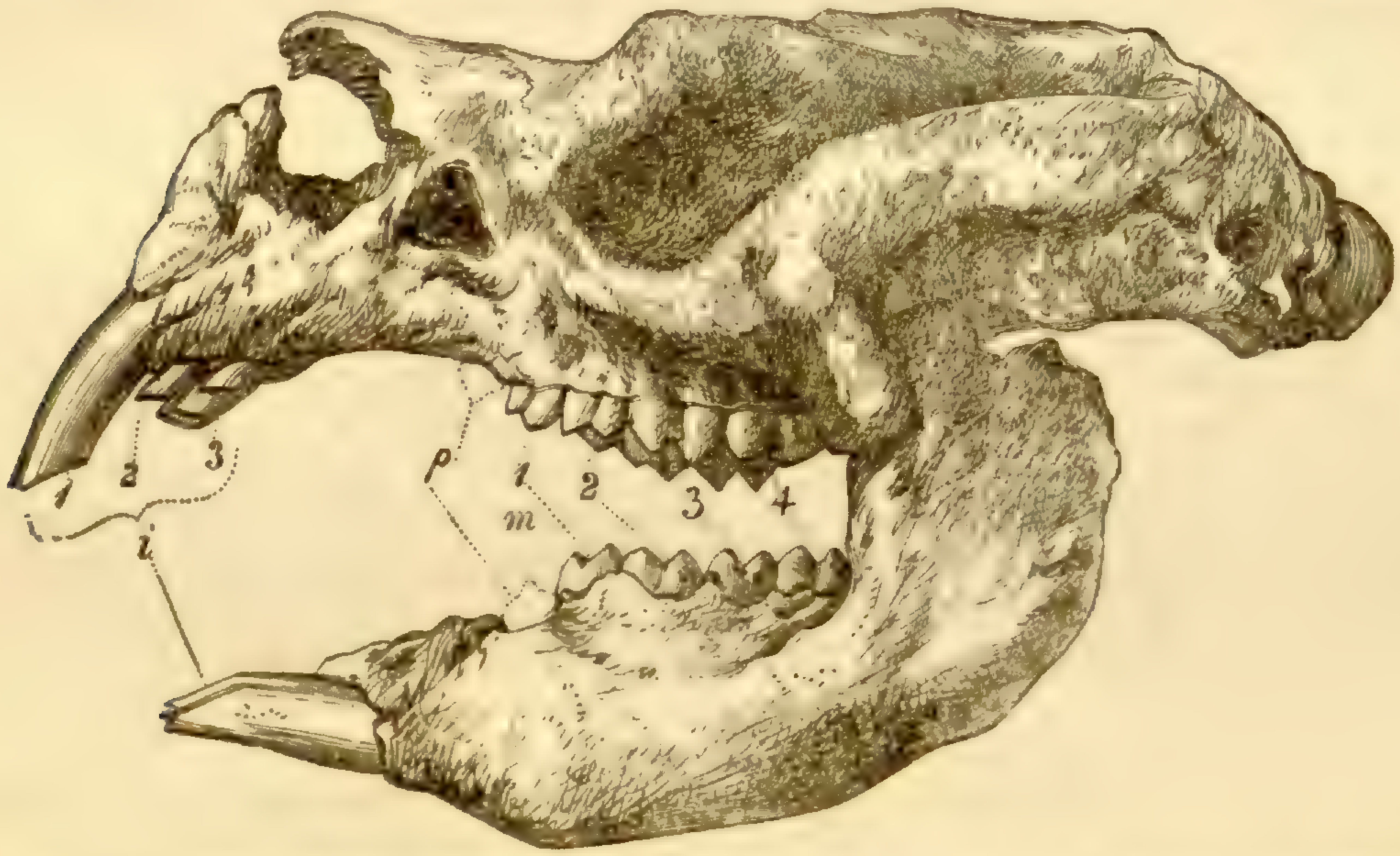

FIG. 1.—*Diprotodon australis* Owen. Extinct marsupial of Australia; one-tenth natural size. From Owen.

introduced to the reader. The illustrations number 357, and are of excellent quality. A majority of them represent the external appearance of the species; but many exhibit the osteology and dentition and a few, parts of the soft anatomy. The order of treatment is from the Monotremata to man, the unguiculate orders being intercalated between the ungulate forms and the Quadrumana. As the Quadrumana are more nearly related to the ungulate than the unguiculate orders, we would have reversed this arrangement. The orders which are treated with the greatest fullness of detail are the Marsupialia, the Diplarthra, and the Quadrumana. The systematic treatment inclines to conserva-

[1] An Introduction to the Study of Mammals, Living and Extinct. By William Henry Flower and Richard Lydekker. London: Adam & Charles, 1891, 8vo., pp. 763.

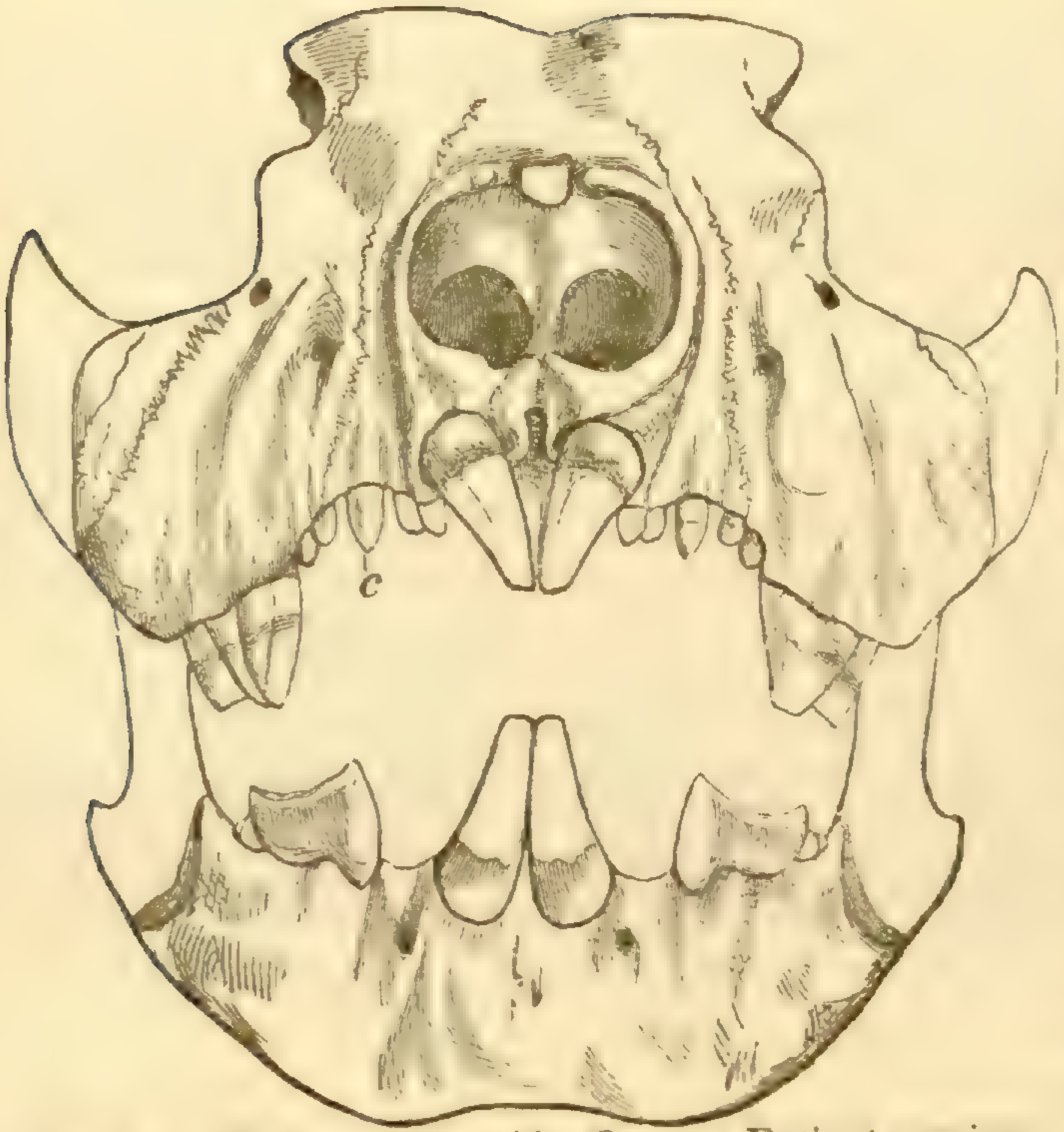

FIG. 2.—*Thylacoleo carnifex* Owen. Extinct carnivorous marsupial of Australia; skull, front view; one-third natural size.

tism, a quality which is of great value in restraining the tendency to excessive subdivision usual among tyros in zoology. In some cases, however, we incline to think it carried too far: as, for instance, when the African rhinoceroses are retained in the same genus with the Indian species; and where all ungulate Mammalia are included in a single order. A little more conservatism would have been consistently shown in the treatment of the Artiodactyla, where the two untenable families Giraffidæ and Antilocapridæ are admitted, and the long list of genera of antelopes is adopted. In the matter of the genera of antelopes, European authors have been apparently unconsciously influenced by the number of species at their disposal, rather than by an observance of the rules they have followed in other divisions.

FIG. 3.—*Dinotherium giganteum* Kaup. Extinct proboscidian from Germany; one-tenth natural size. From Kaup.

A few points where the authors have fallen into error in the matter of American forms may be noticed for the benefit of future editions of the book. Tillodontia are placed under Ungulata, but they are distinctly unguiculate; so also are Chalicotheriidæ which are placed in the

Perissodactyla. The *Coryphodon elephantopus* Cope is figured as *C. hamatus* Marsh. If the figures of the latter given by Marsh are correct, it belongs to both a species and genus distinct from the former. The name of the creodont genus Oxyæna should not be spelled Oxhyæna, as the first syllable of the word hyæna does not enter into its composition. (Dr. Lydekker would also spell the saurian genus Platecarpus "Platycarpus," although its etymology was stated to be from πλατη, an oar, and not from πλατυς, flat.) The cameloid genus Eschatius includes only the species *E. conidens*, and not the *Holomeniscus vitakerianus*. These slight blemishes can be easily removed; and we will hope that a further consideration of the subject will lead to some modification of the systematic arrangement of the orders in a

FIG. 4.—*Dorcatherium aquaticum*; West Africa. From Flower and Lydekker.

future edition. Paleontological research has shown that the unguiculate and ungulate series are distinct from the phylogenetic standpoint, the former remaining tritubercular in molar dentition, while the latter became early quaditubercular and lophodont, and mainly continued so.

The natural character of the order Edentata has been demonstrated by paleontology, and it is treated accordingly in the work before us. An especially valuable section is that devoted to man, which constitutes the most valuable popular review of the subject of physical anthropology that we have.

This book is the only comprehensive one on the Mammalia in the English language, and we know of no better one in any language.—E. D. COPE.

Gems and Precious Stones of North America,[3] by G. F. Kunz, has for its object, to quote from the author's introduction, the presentation of "as many of the facts as possible regarding the precious stones peculiar to the United States, Canada, and Mexico, so that they may be available, not only to the mineralogist, the miner, the mineral and gem collector, the archeologist, and the jeweler, but also to the public; the conditions under which they occur, the methods by which the mining and search for them are conducted, the value and production of different stones, and also an account of the collections in these countries."

Although not pretending to be a complete treatise on gems, the volume certainly approaches nearer to this ideal than any other book published, either in this country or abroad. Not only are the true gem materials carefully described, but other substances more or less frequently used as ornamental stones are ably discussed. Eleven chapters deal with the properties of valuable stones, the history of their occurrence in North America, statements of authenticated finds, descriptions of the most noted gems in the possession of Americans, and many interesting facts concerning their present as well as their prehistoric use. A twelfth chapter treats of pearls in the same detailed manner. Chapters thirteenth and fourteenth give accounts of Canadian, Mexican, and Central American gem localities, and the fifteenth chapter portrays the aboriginal North American lapidarian at work. The sixteenth and last chapter is devoted to definitions to the value of importations of gem material, the methods of preparing it for sale, and to the descriptions of famous American collections.

If space permitted, an abstract of Mr. Kunz's book would be well worth giving; but since no abstract that would be at all worthy of presentation as representative of the great wealth of interesting material found in the volume could be made that would fall within the limits of a review article, it seems best not to insult the artistic tastes of gem connoisseurs by an attempt at a brief outline of this excellent treatise and piece of art,—for the volume is not merely a work on art; it is itself a piece of art. The colored plates of precious stones show these objects in all their beauty; more especially are the plates illustrating the garnets and the tourmalines to be mentioned. In the former we can actually see the sparkle of those magnificent blood-red gems as they lie in a brilliant beam of light, while a glance at the latter must make the heart of any true son of Maine beat fast at the thought of such beauty coming from the rugged hills of his mother state.

[3] A popular description of their occurrence, value, history, archeology, etc. New York: Scientific Pub. Co., 1890, p. 336, vi.; 8 lith. plates and numerous illustrations.

To the gem dealer the book is invaluable, as it gives him at once all that he needs in his business; to the lover of art it will afford many an hour of pleasure; to the gem collector it gives numerous points of interest concerning the rare stones; and to the mineralogist it will prove a veritable mine of information, even in those subjects with which he thinks himself already conversant. Nor will the general reader, if well informed, be disappointed in his perusal of its pages, for he will find everywhere items of news that will add to his stock of useful knowledge, and suggestions that will help to develop his appreciation of the beautiful.

The setting in which the "Gems and Precious Stones of North America" appears is well worthy of such lovely products of nature. The publishers have spared no efforts to enhance their beauty by an appropriate mounting. The plates and illustrations in the volume are excellent, the letter-press is marred by few errors, the paper is heavy, soft, and well tinted, and the binding is very tasty. We expect to hear of the books meeting a ready sale during the coming holiday season, for surely no more acceptable gift could be imagined than a handsome volume on a topic of such interest as the production of exquisite gems in prosaic North America.—W. S. B.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Age and Origin of the Crystalline Rocks of Missouri.[1]—The Geological Survey of Missouri is indebted to Mr. Haworth for a valuable paper on the age and origin of the crystalline rocks of that state. Mr. Haworth's study of these rocks began in the summer of 1886, and he has ever since pursued the subject with enthusiasm and zeal. His paper embodies the more important results obtained from a somewhat extended examination of the crystalline rocks in the vicinity of Pilot Knob. Field work has been supplemented with laboratory examination, and his conclusions are as follows:

I. As to age, he agrees with other geologists in referring them to Archean time.

[1]The Age and Origin of the Crystalline Rocks of Missouri. By Erasmus Haworth. Bull. No. 6, Geol. Surv. of Missouri.

II. As to origin, he is at variance with others who have worked in the same field, in that he holds the porphyries as well as the granites to be ancient eruptives rather than metamorphosed sediments.

The Archean age of these rocks had been fully established, but Mr. Haworth's observations gave him new evidence, confirming the accepted view, which he groups under two heads:

1. Absence of contact metamorphism in the surrounding Paleozoic rocks.

2. Inclusion of numerous fragments of crystalline rocks almost everywhere, in both sandstone and limestone.

In proof of his eruptive theory of the origin of the rocks, Mr. Haworth presents the following evidence in detail:

A. Field evidence of the eruptive origin. 1. Absence of true bedding. 2. Flow structure, banded structure, and lithophysæ. 3. Breccia. 4. Scoria and amygdaloids. 5. Tuff. 6. Absence of gradations of crystalline into non-crystalline rocks.

B. Petrographic evidence of the eruptive origin. 2. Texture of the ground-mass in the porphyries and breccias. 2. Flow structure in the porphyries and breccias. 3. Broken crystals due to the flowage of lava after the crystals were formed. 4. Magmatic corrosion of porphyritic crystals, and of fragments in the breccia. 5. Amygdaloids. 6. Absence of metamorphic minerals.

The paper is well illustrated with plates and sketch maps, which add materially to its value.

The Sulak Gorge.—In a paper on the Transverse valleys in the Eastern Caucasus, Professor Sjögren gives the following description of the Sulak Gorge, below Gimri, in Daghestan: "Among the many valleys of Daghestan that are interesting to the geologist, there are none more remarkable than the channel by which the river Sulak passes through the chain of Cretaceous and Jurassic mountains which borders Inner Daghestan. Just above the entrance to this defile the four rivers Koissu unite in one stream, which, in series of cataracts, tears through a tremendous chasm some fifteen miles in length, cutting the huge ridge almost at right angles to its axis.

"The gorge traverses the main ridge in the direction north, forty degrees east, then changes its line to northwest, which it still follows at the widening of the valley below Tjirkei, and finally comes back to due north, as it passes through the Tertiary hills below Subut. . . . The huge cutting has a vertical depth of from 5,000 to 6,000 feet, while its breadth is so small that the river leaves no room for a proper

road, and scarcely enough for a narrow horse-path, which is itself impassible at certain seasons of the year. The walls of the defile, which mainly consist of a compact dolomite limestone, and show the lines of stratification with unusual distinctness, rise almost perpendicularly into the air, and are altogether unscalable." (*Geol. Mag.*, Sept., 1891.)

An Olenellus Zone in the Northwestern Highlands of Scotland.—At the last meeting of the British Association for the Advancement of Science, Sir Archibald Geikie read an important paper on the results of the geological survey work in Scotland. After referring to the various sedimentary formations which overlie the Lewisian gneiss, and the unsatisfactory evidence of the fossil remains in them as to their stratigraphical correlation, he described the discovery of a peculiar zone of blue or black shales which from their unaltered character promised to be fossil-bearing. This zone lies in what is known as the "Fucoid beds" a few feet below the persistent band of "Serpulite grit." A search was at once begun, and resulted in the finding of undoubted fragments of Olenellus. More recently additional pieces of Olenellus, including a fine head-shield with eyes complete, have been found in another thin seam of black shale interleaved in the "Serpulite grit." The finding of this fossil among the rocks of the Northwest Highlands, and its association with the "Serpulite grit," afford valuable materials for comparison with the oldest Paleozoic rocks of other regions. The "Fucoid beds" and "Serpulite grit," which intervene between the quartzite below and the Durness limestone above, belong to the lowest part of the Cambrian system. The quartzites form the arenaceous base of that system, while the Durness may be Middle or Upper Cambrian. The marked unconformability which intervenes between the Torridon sandstone and the overlying quartzite points to a long interval having elapsed between the deposition of the two discordant formations. The Torridon sandstone must therefore be pre-Cambrian. (*Nature*, Sept. 17th, 1891.)

Origin of Petroleum.—In a recent paper Mr. Ross has endeavored to prove that petroleum is mainly generated by the action of solfataric volcanic energy upon beds of limestone, and gives equations to show that the action of sulphur dioxide and sulphuretted hydrogen on carbonate of lime, with or without water and peroxide of hydrogen, is capable of producing the ethylene and marsh gas derivatives. (*Nature*, Sept. 17th, 1891.)

A Stegocephalian Skull from the Kilkenny Coal Measures.—Dr. Lydekker has described and figured a Labyrinthodont to which he gives the name *Ichthyerpetum hibernicum*. The interest of the specimen lies in the relationships of the genus to which it belongs. Mr. Lydekker believes it to be a member of the group containing Brachyops, Bothriceps, and Micropholis, all of which are characterized by their more or less parabolic skulls and forwardly placed orbits. Also, certain lines of evidence point to the conclusion that Ichthyerpetum and Pholidogaster are identical. In that case, the type of Stegocephali common throughout the European Carboniferous was represented in the Lower Gondwanas by the genus Brachyops, while we find it surviving in the Hawkesbury beds of Australia, where it is represented by Bothriceps; a member of the latter genus, together with Micropholis, also occurring in the great Karoo system of South Africa. This seems to be another instance of the persistence of types in the Indian, Australian, and Ethiopian regions during long ages after their total disappearance from the palæarctic area. (*Quart. Journ. Geol. Soc.*, Vol. XLVII., Pt. 3, 1891.)

A New Ichthyosaurus.—Dr. Albert Gaudry calls attention to a gigantic Ichthyosaurus, which, after having figured in the exposition of 1889, has been generously donated to the Natural History Museum of Paris by MM. Millot, the owners of the quarries where it was discovered. This fossil was found in the chalk of the Upper Lias of Sainte-Colombe, near l'Isle-sur-Serein, about 12 kilometers from Vassy (Yonne). It is the largest Icthyosaurus ever found in France, measuring 8 metres in length. The head is 1m, 57 long; the anterior extremity is broken, but its length is judged to be about 1m, 80,—that is to say, 24 centimeters more than *Ichthyosaurus platyodon* of England; the eye, ornamented with sclerotic plates, has a diameter of cm. 24; the snout is very much prolonged, and there are about 24 teeth on one side, counting those of both upper and lower jaws; twenty-four vertebræ, altogether 4m, .40 in length, are preserved. The anterior and posterior limbs are joined to the skeleton, but many of their bones are lost, and the remaining ones are scattered.

After having compared this magnificent reptile of Burgogne with other known Ichthyosaurs, M. Gaudry considers it intermediate between the two principal groups, those of Longipinnes and Latipinnes, and proposes to name it, provisionally, *Ichthyosaurus burgundiæ*. (*Revue Scientifique*, Aug., 1891.)

The Skull and Hind Extremity of Pteranodon.—Early in the season of 1876 the writer collected from the Cretaceous of Kansas the first approximately complete skull known of an American Pterodactyl. Upon this specimen Professor Marsh, in the June number of the *American Journal of Science* for that year, founded the "order" Pteranodontia, expressly stating of the specimen that it might be "regarded as the type of the genus Pteranodon." Eight years later, in the May number of the same journal, he gave a fuller description of this same specimen, figuring it under the name *Pteranodon longiceps*.

The specimen consists of the skull alone, and was discovered partly exposed on a gently sloping surface, in the vicinity of Monument Rocks. Aside from an unfortunate stroke of the pick that chipped off the tip of the bill, the specimen was otherwise incomplete, in that the distal part of the occipital crest was lost. In his plate Professor Marsh restored this crest from the indications presented by the basal portion, but without indicating in his paper that such a conjectural restoration had been made. The result is unfortunate.

The writer the present season has been fortunate in securing for the University of Kansas a yet more complete skull of apparently the same species, discovered by his assistant, Mr. E. G. Case, in the immediate vicinity of the place where Professor Marsh's specimen was found. The specimen, while agreeing essentially with the type specimen, has a crest not more than half as long as that figured by Marsh, and with a very different outline, in that the posterior inferior border is angulated and concave. The crest is much thinner than is figured by the artist. The animal did not have nearly so remarkable a skull as the figures would indicate.

"There was apparently no ring of bony sclerotic plates, since in the best preserved specimens no traces of this has been found."[1] Nevertheless, well ossified sclerotic plates do exist in Pteranodon, as our specimen shows. They are from six to eight millimeters in diameter, and similar in texture and shape to, though without the imbrications of, those of the Mosasaurs (the so-called dermal scutes of Marsh).

Several unusually perfect specimens in the Museum of Kansas University enable me to give the chief characters of the pelvis and legs of Pteranodon, parts hitherto but little known,[3] and which will be supplemented, as also those of the skull, by figures given later.

In no especial respect do those parts present unusual features among

[1] Marsh, *Amer. Journ. Sci.*, XXVII., p. 425.

[3] See Marsh, *Amer. Journ. Sci.*, Dec., 1876.

the Pterodactyls. The ilium has a long anterior projection, with an expansion at or near the front end. Posteriorly it extends more stoutly upward and backward from the acetabulum, to form a close union with the three posterior sacral vertebræ, terminating in a stout, styliform tuberosity on either side of the base of the tail. The pubis and ischium are thoroughly coössified throughout (there may be a slit-like indication of an obturator foramen below), forming a broad, anteroposterior plate, which is narrowed to form a symphysis of about one inch in length, in the medium-sized species. Projecting downwards and forwards, about midway between the acetabulum and symphysis, there is a moderately thickened, angular projection, evidently tipped with cartilage in life. It corresponds to the pectineal process, and may have been for the attachment of pectineal or rectus muscles, or for the so-called prepupic bone, a bone I have never seen in the hundreds of specimens which I have examined. A little below the acetabulum, and a little before the middle of the conjoined plate, there is a moderate sized, oval, anteroposterior, pubic foramen. On the border of the ischium behind, a little above the symphysis, is another tuberosity, larger and stouter than the pubic one. Between this tuberosity and the iliac tuberosity directly above, there is a large, deep sciatic notch. These two tuberosities seem to indicate that the animal in life was in the habit of resting upon these parts, a supposition further helped by the weakness of the legs and by the structure of the femur. There are indications of seven sacral vertebræ in the specimen described. Marsh has given five as the number in one species. With the specimen were two apparantly basal caudal vertebræ of small size. The femur is a moderately stout bone, considerably shorter than the tibia, considerably curved, with a slender neck, set at only a slight angle with the shaft, nearly spherical head, and small trochanter,—all of which, together with the rather shallow imperforate acetabulum, would indicate great freedom of movement in the legs. The tibia is a slender bone, without marked cranial crest, and with a well-developed trochlear surface below. I know of no indications of a separate fibula. The foot is elongate and slender, the metatarsals articulating closely together above, the claws much smaller than those of the manus, and only slightly curved. There are three tarsal bones, two of them cuboid or angular, the third larger, and with a downward directed, pointed, hook-like process. It evidently indicates a rudimentary digit. There are four functional toes, the four elongate metatarsals in length indicated by the numbers 2, 1, 3, 4, of which the second is the largest. The phalanges may be represented by the formula I-2, II-3, III-4, IV-5;

thus, as in the European Pterodactyls, corroborating the evidence that the fifth toe is the one that is rudimentary. All these phalanges are slender, excepting the second ones in the third and fourth toes, where they are scarcely longer than wide.

From evidence obtained in the field and in the laboratory, I think I can safely say the following in general of the American Cretaceous Pterodactyls. About five or six species are known, varying in size, when alive, of from about four feet to not over twenty feet in expanse of wing.[4] The head (in all the larger species, at least) was elongate and slender, with a well-developed occipital crest, and without teeth. The jaws may have been encased in horn, but I have never seen any evidence whatever that such was the case. The neck was moderately elongate and slender; the thoracic girdle very stout and rigid, supported above, in some species at least, by union with the coössified thoracic vertebræ, below by the stout anterior projection of the large, rounded, thin sternum. The arms and wrists were very powerful; the second, third, and fourth fingers, as Marsh has shown, small and short, but terminating in strong, recurved claws; the fifth, or extraordinarily developed wing-finger, having very great freedom of backward movement at the extremity of the elongate metacarpal, and with only limited motion between the four phalanges. The body was short, the pelvis of moderate size, the hind legs comparatively small, with great freedom of movement, the tail short, and the feet without much, if any, prehensile power. Their food probably consisted of fishes.[5]

All the bones throughout the skeleton are very thin-walled and pneumatic. The haversian canals and lacunæ are small.—S. W. Williston.

Geological News.—General.—Mr. J. B. Tyrrell reports a deposit of mineral resin resembling amber along the ridge of a beach on the west shore of Cedar Lake, North Saskatchewan, Canada. It has evidently been washed up on shore by the waves, but its exact age has not been determined. (*Am. Journ. Sci.*, October, 1891.)

Archean.—Mr. J. W. Gregory is convinced that the Tudor specimen of Eozoon is not of organic but of mineral origin. (*Quart. Journ. Geol. Soc.*, August, 1891.)

[4] This expanse has often been given much greater than this, but I have actually measured the largest species (*P. umbrosus* Cope), and know that the size cannot exceed that given above.

[5] Several coprolites found within the above-described pelvis, ellisoidal in shape, and about the size of an almond, showed bones so finely comminuted that their precise character could not be made out.

Paleozoic.—Recent observations by S. Calvin render it certain that the Independence shales do not constitute the lowest number of the series of Devonian rocks of Buchanan county, Iowa, but that they were preceded by brecciated limestone of Devonian age. (*Am. Geol.*, September, 1891.)——Mr. Middlemiss suggests that the sub-Cambrian salt marl of India has no ordinary stratigraphic relations with the rest of the series, but is of plutonic, igneous, or deep-seated origin, introduced in Tertiary times, accompanied by lateral and vertical disturbance, thrusting, and shearing. (Geol. Surv. India Records, Vol. XXIV., Pt. I., 1890.)——Dr. Traquair has catalogued fifty species of fossil Dipnoi and Rhipidopterygia of Fife and the Lothians. The geological interest of these fish beds is the abundance of fish remains in estuarine strata below the horizon of the Millstone grit. (Proceeds. Roy. Soc. Edinburgh, Vol. XVII., p. 385.)——Mr. Davis has described a new fossil fish, *Strepsodus brockbankii*, found in the Limestone of the Upper Coal Measures near Manchester, England. (*Geol. Mag.*, October, 1891.)——A collection of Lower Helderberg fossils from Albany, N. Y., has yielded a new genus of Ostracoda, described by E. O. Ulrich under the name Beecherella. Seven species of this new genus are figured in the October number of the *American Geologist*.

Mesozoic.—Mr. Wilson calls attention to the color-markings on a species of Brachiopoda, *Waldheimia perforata*, from the Lower Lias of Gloucestershire, England. The color indications are in the form of clearly defined concentric bands of black and white, of varying breadth. These bands are bilaterally symmetrical, and correspond in the two valves. (*Geol. Mag.*, October, 1891.)

Cenozoic.—According to G. H. Stone, the following-named classes of deposit are represented in the asphalt fields of Western Colorado and Northeastern Utah: (1) Asphaltic sand-rock, (2) bituminous shales or marls, (3) bituminous limestones, (4) outflow or overflow asphalt. These are lacustrine deposits, and will therefore present conditions somewhat different from those of marine beds. (*Am. Journ. Sci.*, August, 1891.)——Mr. Gilbert attributes the small anticlinal disturbance of a cliff of Devonian shale in Western New York, near Lake Erie, to the post-Glacial rise of temperature and consequent expansion of the rocks. Like other small ridges of Devonian shale in Northwestern Ohio and of Trenton limestone in Northern New York, they are shown to have been formed after the departure of the last ice-sheet. (*Am. Geol.*, October, 1891.)

BOTANY.

The Trees and Shrubs of the Basin of the Red River of the North.—In a recent paper on the "Geographic Limits of Species of Plants in the Basin of the Red River of the North"[1] Mr. Warren Upham discusses a number of interesting problems in geographical botany. This basin lies between 45° and 52° north latitude, and 95° and 106° west longitude. At its lowest point at Lake Winnipeg its elevation above sea-level is 710 feet, and from this it rises to 2,700 feet in Northwestern Manitoba and Eastern Dakota. The temperature of this valley ranges from 90° Fahrenheit to —30°, or even —40°. The annual rainfall is from 20 to 30 inches.

The boundary between forest and prairie is traced as follows: Beginning near the junction of the north and south forks of the Saskatchewan River (about lat. 53° north, long. 105° west), and running southeasterly to Duck Mountain, the south end of Lake Manitoba and Lake Winnipeg, thence southerly from fifteen to fifty miles east of the Red River to Central Minnesota, where it bears eastward, passing out of the Red River basin. West of this line the region is chiefly grassland, while east of it the surface is almost wholly timbered. "Groves of a few acres, or sometimes a hundred acres or more, occur here and there upon the prairie region beside lakes, and a narrow line of timber usually borders the streams, as the Red River and its principal tributaries; but many lakes and creeks, and even portions of the course of large streams, have neither bush nor tree in sight, and occasionally none is visible in a view which ranges from five to ten miles in all directions."

Mr. Upham discusses the trees and shrubs of the region as follows: "Many species of trees, which together constitute a large part of the eastern forests, extend to the Red River basin, reaching there the western or northwestern boundary of their range. Among these are the basswood, sugar maple, river maple, and red maple, the three species of white, red, and black ash, the red or slippery elm, and the rock or cork elm, the butternut, the white, bur, and black oaks, ironwood (*Ostrya virginica* Willd.), the American hornbeam (*Carpinus caroliniana* Walt.), the yellow birch, the large-toothed poplar, white and red pine, arbor vitæ, and the red cedar or savin. A few species of far northern range find in this district their southern or south-

[1] Proc. Boston Society of Natural History, Vol. XXV., p. 140.

western limit,—namely, our two species of mountain ash, the balsam poplar, banksian or jack pine, the black and the white spruce, balsam fir, and tamarack.

"Some of the eastern shrubs, which make the undergrowth of our forests, also attain here their western limits; but a larger proportion of these than of the forest trees continues west along the stream-courses to the Saskatchewan region, the upper Missouri, and the Black Hills. Among the shrubs that reach to the borders of the Red River basin, but not farther westward, or at least southwestward, are the black alder or winterberry, and the mountain holly, staghorn sumach, the hardhack, the huckleberry, the dwarf blueberry, and the tall or swamp blueberry (*Vaccinium pennsylvanicum* Lam., and *V. corymbosum* L.), leatherwood (*Dirca palustris* L.), and sweet fern. Shrubs and woody climbers, that have their northern or northwestern boundary in this basin, include the prickly ash, staff-tree, or shrubby bitter-sweet, frost grape, Virginian creeper, and the four species of round-leaved, silky, panicled, and alternate-leaved cornel (*Cornus circinata* L'Her., *C. sericea* L., *C. candidissima* Marsh [*C. paniculata* L'Her.], and *C. alternifolia* L. f.). On the other hand, shrubs of the north which reach their southern or southwestern limits in the Red River basin, include the mountain maple, the few-flowered viburnum and witherod, several species of honeysuckle (*Lonicera ciliata* Muhl., *L. cærulea* L., *L. oblongifolia* Hook., *L. involucrata* Banks, *L. hirsuta* Eaton), the Canada blueberry, the cowberry, *Andromeda polifolia* L., *Kalmia glauca* Ait., Labrador tea (*Ledum latifolium* Ait.), the Canadian shepherdia, sweet gale, the dwarf birch, green or mountain alder, beaked hazel-nut, *Salix balsamifera* Barratt, and *S. myrtilloides* L., var *pedicellaris* Anders., black crowberry, creeping savin, and the American yew or ground hemlock.

"No tree of exclusively western range extends east to the Red River basin, and it has only a few western species of shrubs, of which the most noteworthy are the alder-leaved June-berry or service berry (in Manitoba commonly called 'saskatoon'), the silver-berry (*Elæagnus argentea* Pursh), and the buffalo-berry (*Shepherdia argentea* Nutt.). To these are also to be added the shrubby *Œnothera albicaulis* Nutt., which occurs chiefly as an immigrant weed, and the small-leaved false indigo (*Amorpha microphylla* Pursh), which abounds on moist portions of the prairie. The silver-berry (usually called 'wolf willow' in the Red River valley) is common or abundant from Clifford, North Dakota, and from Ada, Minnesota, northwood, forming patches ten to twenty rods long on the prairie, growing only about two feet high and

fruiting plentifully, but in thickets becoming five to ten feet high. Its silvery whitish foliage and fruit make this shrub a very conspicuous and characteristic element of the Red River flora.

"The single species of true sage-brush belonging to this basin (*Artemisia cana* Pursh) extends east in North Dakota to the Heart Mound, six miles northwest of Walhalla, or thirty-five miles west of the Red River at Pembina, and to a hill close west of the Cheyenne River about eight miles south of Valley City, growing in both places on outcrops of the Fort Pierre shale. It attains a height of one to three feet, and the tough wood of its base is one to one and a half inches in diameter. *Artemisia frigida* Willd., called 'pasture sage-brush' by Macoun, is abundant throughout a wide area westward, extending east locally to 'the ridge' east of Emerson, Manitoba, the Falls of St. Anthony, and Lake Pepin."

The Bearberry in Central Nebraska.—Another of the puzzles in the geographical botany of the plains has recently turned up in the discovery of the bearberry (*Arctostaphylos uva-ursi* Spreng.) in a cañon in Custer county, in the center of the state. When it is remembered that this station is midway between the Missouri River and the foothills of the Rocky Mountains, and that the plains extend for hundreds of miles in every direction, and further, that it is in what is known as the "sand-hill belt," it puzzles one to account for the presence of this unlooked-for shrub.

Bearberry occurs in the Black Hills and in the Rocky Mountains. Northeastward its nearest station is near Lake Pepin in Minnesota. It does not occur in Iowa. In Missouri it occurs in the southeastern part only. It is doubtfully admitted by B. B. Smyth to his list of Kansas plants.

The Nebraska station is in the basin of the Loup River, a stream whose numerous branches are wholly confined to the central part of the state, all having their sources in the numberless springs of the "sandhills." How did the Nebraska bearberry find its way to this out-of-the-way spot?—CHARLES E. BESSEY.

ZOOLOGY.

Preservation of Color in Animals in a Collection.—M. Richard Thorna, of Dorpat, Russia, believes that he has discovered a liquid that will preserve the natural color of zoological specimens. After washing, the animal is to be preserved in the following solution :

Sulphate of soda	100 grams.
Chloride of sodium	100 "
Chlorate of potash	100 "
Nitrate of potash	10 "
Water	1 litre.

The specimen must remain in the liquid from eighteen to twenty-four hours, after which it is to be put in alchohol, which must be changed once or twice. Animals so treated will keep their color, the tints of which will be slightly deepened. (*Revue Scientifique*, 27 June, 1891.)

The Structure of Serpula.—Mr. A. L. Treadwell describes[1] some points in the structure of the New England *Serpula dianthus*. He first points out that Professor Verrill in his original description has confounded dorsal and ventral surfaces in this worm, and then proceeds to describe the general structure of hypodermis, nervous system, tubiparous glands, and sex products. The digestive, muscular, and circulatory apparatus, etc., are much like those in Spirographis, described by Claparède, and hence are omitted. Most noticeable is the nervous system, in which the œsophageal commissures are double, the upper commissure on each side being almost entirely composed of nerve-cells. The much convoluted tubiparous glands lie in the firs body segment, and extend backwards to about the middle of the second segment.

Metamerism in Hexapods.—As a result of studies on the embryology of the cockroach, Professor Aug. Lameere, has arrived at the following conclusions :[2] The order of succession of the mouth parts as given by Savigny is accepted. In the head four pairs of cœlomic cavities are recognized, plus a median unpaired cavity, corresponding to the labrum which the author would homologize with the cavity of the anterior directions of the Actinozoa. The antennulæ of the Crus-

[1] *Zool. Anz.*, XIV., 200, 1891.

[2] Bull. Soc. Micros., Belg., XVII, 1891.

tacea and the cheliceres of the Arachnids are homologous with the antennæ of the Hexapods. The editor of the NATURALIST has reasons for believing that as soon as we know anything about the embryology of the Thysanures, many points in Hexapod morphology and in the relationships of the various Arthropod groups will receive a flood of light.

Cottus beldingii, sp. nov.[3]—In October, 1889, Mr. L. Belding obtained three specimens of a species of Cottus in Lake Tahoe, California. During June, 1890, we obtained a much larger number at the same place. A series of these was sent to the British Museum. The rest are in the collections of the California Academy of Sciences, No. 504. Mr. Belding's specimens are also in the collections of the Academy, No. 702. We also obtained a number from Donner Lake, California, No. 505, California Academy of Sciences.

These specimens represent a variety or species distinct from the Alaskan *Cottus minutus*,[4] with which it is most closely related.

Head 2¾–4; depth 4–5; D. VI.–VIII. 15½–18; A. 11–13; V. I. 4.

Head rather short and broad, the profile convex, more steep from eye forward; eye large, orbit 4–5 in head; interorbital concave, 2 in orbit; mouth large; maxillary reaching at least to below the pupil, about 2 in the head. Preopercle with a simple, backward-directed spine, very slightly curved upwards. Teeth on jaws and vomer, none on palatines. Skin smooth. Pectorals reaching vent, or further in young; ventrals 1⅓–2 in head. Distance of anal from caudal 1⅓ in its distance from snout. Anus nearer insertion of caudal than to end of snout. Mottled with black and white. About six blackish cross-bars on back; the first across head just behind eyes, next at origin of dorsal. First dorsal tinged with rust, the second less so. All the fins except the ventrals spotted with dark. The ground color varies greatly with the bottom over which these fishes live.

The other species found at Lake Tahoe were *Phoxinus montanus* Cope, *Agosia oscula* Girard, *Algansea obesa* Girard, *Coregonus williamsoni* Girard, *Catostomus tahoensis* Gill and Jordan; *Salmo mykiss henshawi* Gill and Jordan. Besides these we obtained *Algansea olivacea* Cope, from Donner Lake.—C. H. AND R. S. EIGENMANN.

[3] We have lately examined series of specimens belonging to the Academy of Sciences which makes it quite certain that *Cottus gulosus* Girard is identical with *Cottus asper* Richardson.

[4] Dr. Jordan tells us the name *Cottus minutus* is preoccupied, and not available for the Alaskan species.

A New Diodont.—The fishermen at San Pedro during the past summer took a species of Chilomycterus which is the first that has been recorded from the Pacific coast of America. On account of the unreasonable price asked for it I did not obtain it, but took the following notes, which may serve to identify another specimen:

CHILOMYCTERUS CALIFORNIENSIS, sp. nov.—One specimen, 9⅞ in., San Pedro, California, July, 1891. No tentacles anywhere. Spines of back all low, those of front especially so, increasing in size towards belly, where they become much larger than those of the back. No spine on middle of forehead. A spine at upper anterior angle of orbit; one above, somewhat behind its middle; one slightly behind and above its upper posterior angle; another halfway between the last and the upper angle of pectoral; and another before and a little above the upper margin of the pectoral. Blue above, white below. Forehead and bases of all the fins with small ($\frac{1}{16}$ in.) dark spots, fewer on anal. Back densely covered with short streaks or bars, which become larger spots on sides. A few round, dark spots (¼ in. in diameter) on belly. Spots below eye larger than those on forehead, similar in size to those of caudal peduncle.—C. H. EIGENMANN, *Bloomington, Ind., Oct. 8th, 1891.*

Temperature and the Number of Vertebræ in Fishes.—Dr. Jordan's recent paper[5] on this subject possesses considerable interest. He shows by a review of the known facts that in those groups of fishes which have representatives in the tropics and in colder waters as a rule those species which come from the warmer waters the number of vertebræ is less than in the colder water relatives, a law which was first brought out by Dr. Gill. Dr. Jordan has collated a large number of facts, all bearing on this subject. It may be suggested that the same influences which cause this diversity have possibly given rise to the change of shape in the same species of mollusc as brought out by Prof. E. S. Morse.

Note on Gyrinophilus maculicaudus Cope. — In the year 1889 Mr. A. W. Butler, of Brookville, Indiana, presented to Prof. E. D. Cope some specimens of a tailed batrachian that had been taken near the town named, in Southeastern Indiana. They had been collected, I believe, by Mr. E. W. Quick, and had been suspected by both Mr. Butler and Mr. Quick to be an undescribed species related to *Spelerpes longicaudus*, which they greatly resembled. Prof. Cope's practiced eye immediately perceived that they were not members of the

[5] Proc. U. S. Nat. Mus., XIV., p. 107, 1891.

species named, and the results of his examination of the specimens were published in the AMERICAN NATURALIST, Vol. XXIV., page 967. Prof. Cope named the species *Gyrinophilus maculicaudus*, assigning it to this genus because he found the premaxillaries distinct, instead of being anchylosed, as they are in Spelerpes. The species is otherwise distinguished from *Spelerpes longicaudus* by having a broader, flatter head; differently disposed vomerine teeth; by a ground color of vermilion; and by a different arrangement of the black spots. The limbs are also longer than those of *S. longicaudus*.

I have had opportunities to examine several specimens, both living and alcoholic, of this beautiful species. Some of these have come to me from Brookville through the kindness of Messrs. Butler and Quick. Two others had been taken in the vicinity of Bloomington, Indiana, by Prof. B. W. Evermann, of the State Normal School. After making a careful examination of the premaxillaries of several specimens of *maculicaudus* and comparing them with those of *longicaudus*, I am compelled to differ from Prof. Cope as to the generic position of this animal. In the case of all the specimens that I have dissected, except one, I find the premaxillaries to be consolidated. I have taken the premaxillaries out, dried them, and examined them with a sufficiently high power of the compound microscope, without perceiving any evidences of a suture between them. I can see but slight differences between the premaxillaries of it and *S. longicaudus*. In Gyrinophilus the premaxillaries are easily separated. In the case of the exceptional specimen mentioned above, the premaxillaries had been broken by accident just a little to one side of the middle line. Had the fracture been exactly in the middle line, I should have concluded that in this specimen the two bones had not united. This suggests that possibly an accident had happened to the specimen examined by Prof. Cope. If, however, Prof. Cope's specimen really had the premaxillaries distinct, while in mine they are anchylosed, the genus Gyrinophilus cannot stand. In any case, the species will, according to my view, have to bear the name *Spelerpes maculicaudus*.

This animal is regarded by those who have observed it in its native haunts to be more aquatic in its habits than is *S. longicaudus*. The ones that I kept for some time in a small aquarium showed a disposition to remain out of the water. They would often climb up on the perpendicular glass wall of the aquarium above the water, and rest there for a long time. If, when thus adhering to the glass, this was turned in a horizontal position, they would continue to stick to the under side

of it. I was not successful in my endeavors to get them to eat while in confinement. They appear to endure imprisonment well.

During the summer of the present year my son, W. P. Hay, secured two additional specimens of this cave salamander in the region about Bloomington. One of these was taken in May's Cave, about five miles south of Bloomington and a mile west of Clear Creek Station. It was found sticking to the wall of the cave, about four feet above the water and about one hundred yards from the cave's mouth. The other was captured in Kern's Cave, one mile southwest of Bedford, in Lawrence county. This locality is twenty miles south of May's Cave, and both are about a hundred miles west of Brookville, the original place of the discovery of the species. This shows that the animal is pretty well distributed throughout the southern portion of Indiana, and will probably occur also in the caverns of Kentucky. The specimen taken in Kern's Cave was also found clinging to the wall above the water, and at a distance of about a quarter of a mile from the entrance. Neither of the specimens made any effort to escape capture. Attention was attracted to both by the gleaming of their eyes in the candle-light. —O. P. Hay.

Color Patterns in Cnemidophorus.—At the last meeting of the American Association for the Advancement of Science I read a paper on the color variations in two species of the above-named genus of lizards, the *C. gularis* B. & G. and *C. tessellatus* Say. In the young of both species the color consists of longitudinal stripes, six in the former and four in the latter, which has a lateral series of spots in place of the external stripes. This coloration is permanent in some of the *C. gularis* and in the *C. t. gracilis*. In both species can be traced an identical series of color varieties, which have especial geographical ranges, and which have mostly received names as species. The first modification is seen in the appearance of pale spots in the interval between the stripes, a character which partly defines the *C. gularis* B. & G. These spots are greatly enlarged in the *C. gularis scalaris* Cope, joining the stripes and breaking up the ground color into spots. On the other hand, the stripes may also be broken up into spots, producing a light-spotted form, the *C. g. communis* Cope. Returning to *C. g scalaris*, the dark spots may be confluent transversely. forming a transversely banded form. This transverse banding commences at the posterior extremity of the body. When it is restricted to this region and the anterior color pattern disappears, we have the

C. g. costatus Cope. When the color pattern consists of rows of oblong black spots on a dark ground the form *C. g. semifasciatus* Cope is produced.

We have the following results: 1. A longitudinally striped pattern passes into a transversely banded form, etc. 2. This series of changes is common to both species, *C. gularis* and *C. tessellatus*. 3. This series and some of the other variations are found in the *Lacerta muralis* of Southern Europe, as described by Eimer. 4. This kind of variation is not promiscuous or multifarious, but in series.—E. D. Cope.

A Rorqual on the New Jersey Coast.—A young specimen of Balænoptera came ashore at Ocean City, Cape May county, N. J., recently, and was secured for the Academy of Natural Sciences of Philadelphia by the efforts of Prof. A. Heilprin, Dr. S. G. Dixon, and Mr. J. I. Ives. It had been dead for a considerable time, and had lost its whalebone. Its long maceration rendered it possible to procure the skeleton in very good condition. It measured in the flesh 66 feet 11 inches in length; head to angle of mouth on curve, 16 feet 10 inches. The entire surface was of a purplish slate color, mottled with large blotches of a lighter tint; under surface of flippers, white. The characters of the skeleton are those of the *B. musculus*, with certain important exceptions, in which it resembles the *B. sibbaldii*. These are the enclosure of the vertebrarterial canal in the axis vertebra only; the large size, and the color. A full description of it will be published in the Proceedings of the Philadelphia Academy.—E. D. Cope.

New Mammals.—In *North American Fauna*, No. 5, Dr. C. Hart Merriam describes the vertebrate fauna of Southern Idaho. First is a general review of the region and its faunal provinces, and then follow annotated lists of species. Of mammals sixty-seven species are recognized, the following being new: *Sorex idahoënsis*, *S. dobsoni*, *S. vagrans similis*, *Onchomys leucogaster brevicaudus*, *Hesperomys crinitus*, *Arvicola macropus*, *A. mordax*, *A. nanus*, *Phenacomys orophilus*, *Evotomys idahoënsis*, *Thomomys clusius fuscus*, *Lepus idahoënsis*. The only new bird found was *Megascops flammeolus idahoënsis*, which is given a colored plate. The reptiles and Batrachia are catalogued by Dr. L. Stejneger, but embrace no novelties. In the same number Dr. Merriam also describes *Microdipodopus* [n. g.] *megacephalus* from Nevada, and *Evotomys gapperi brevicaudus* from the Black Hills.

Zoological News.—M. Aug. Lameere, professor in the University of Brussells, has published[6] a very readable paper on the "Origin of the Vertebrates." He defends and amplifies Sedgwick's well-known hypothesis, and like him derives the vertebrates, and by implication metamerism, from the Actinozoa.

C. Dwight Marsh publishes[7] a list of the deeper water Crustacea in Green Lake, Wis. He enumerates fourteen species, of which a Bosmina is new and *Diaptomus minutus* was before known only from Newfoundland.

EMBRYOLOGY.[1]

A New Larval Form from Jamaica.—The Marine Laboratory of the Johns Hopkins University was situated during the summer of 1891 on the Island of Jamaica, at a point on Kingston Harbor called Port Henderson. While a member of the party I obtained the larva described below. On the morning of June 24th, while examining the tow-stuff from the surface net, Mr. Charles Taylor, of Kingston, discovered the larva. He made a careful sketch of it from the living animal, and it is from this largely that the accompanying figure was subsequently made. The larva was turned over to me, but unfortunately on account of its minute size it was lost during the hardening process, so that all opportunity of a later and fuller examination is gone. Nevertheless, as I am quite sure the figure is accurate as far as it goes, and as the chance of finding another larva is not very good, I have decided to figure it, with a brief account of its capture.

Although there is no record as to the time in the morning when the tow was made, yet in all probability it was between the hours of six and nine A.M. About six or seven o'clock the land breeze that had been blowing during the night ceased, and there was generally a calm interval of an hour or two before the sea breeze (the trade) forced it way

[6] Bulletin Société Belge de Microscopie, XVII., 1891.

[7] *Zool. Anzeiger*, XIV., 275, 1891.

[1] Edited by Dr. T. H. Morgan, Bryn Mawr College, Bryn Mawr, Pa.

inland again. During these calm hours in the morning all the more important collecting was done.

The larva is undoubtedly a free-swimming stage of one of the marine Trematodes. Such pelagic larvæ—Cercaria—are not unknown, but have been now and then recorded by naturalists. The adult worms generally live, I believe, in marine molluscs, and the Cercaria is a larval form seeking a new host. The larva belougs to that division of marine larval Cercaria having bifid tails. Villot says that these Cercaria having split tails form a small very natural group, and are mostly found parisitic in fresh-water Mollusca; but a few are marine. One of these has been recorded by J. Müller as having been found near Nice, and has been figured in the inaugural thesis of Lavalette Saint-George, under the name of *Cercaria dichotoma*. I have not seen this figure, but judging from the account of the same larva given later by Claparede it is entirely different from the Jamaica larva.

TREMATODE LARVA.

Claparede, in 1863, figured a bifid-tailed Cercaria found in the sea. This is also quite different from the Jamaica Cercaria. The larva figured by Claparede is called *Bucephalus haimeanus*, and is very close, the author says, to *B. polymorphus*, described by Von Baer, and is the same as that described by Lacaze Duthier which lives in the mollusc Cardium. Both of these larva then figured by Von Baer and Lacaze Duthier must be different from the present form.

McCrady, in 1873, described a bifid-tailed Cercaria—*Bucephalus cuculus*—living in the American oyster. His figures show at once that the form he described is very different from the Cercaria from Jamaica.

Other descriptions than these I do not know of, and feel reasonably assured that the larva has not been figured before.

The Jamaica larva was a small, jelly-like, transparent body, being, at a guess, about a half a millimeter in length. It moved about quite actively by means of its tail. The latter structure is situated in a groove

on one side of the body, as shown in the figure. At about its middle the tail splits into lamella-like paddles, and it is this divided tail that forms the most interesting feature of the larva. On each side of the anterior end of the larva is a mass of dark granular mass. The other bodies found in the interior of the larva are shown in the accompanying figure.

We never succeeded in getting more of these Cercaria, although I looked for them on several occasions.—T. H. MORGAN.

Hatschek's Interpretation of the Annelid Trochophore.—Zoologists and embryologists have looked forward with a good deal of interest to the publication of the third part of Dr. Berthold Hatschek's "Lehrbuch der Zoologie," in which he gives what may be considered the most recent and certainly the most novel treatment of that very heterogeneous group, Vermes (Zygoneura Hatschek).

More especially interesting is the treatment of the larval form of the Annelids,—the Trochophore. This is ground that Hatschek has himself covered very thoroughly, and his words must carry a great deal of weight along with them, whether his particular view be accepted or not.

"The Trochophore is the characteristic larval form of the Zygoneura. In structure, the Rotifers stand very near to the Trochophore, and the Turbellarians which only reach the stage of the Protrochula are very closely related to this last form. In many cases the characteristics of the Trochophore are more or less modified, or even entirely suppressed, as happens in direct development. The primitive type of the Trochophore may be determined by a comparison of those structures that are repeated in very widely separated groups of animals. A complete union of all the typical properties in a single larval form is perhaps never reached, still many Annelid larvæ approach very near to this." A very clear and full description is given of a typical Trochophore. This is illustrated by four new diagrams, that show the structure of the larvæ most excellently.

With respect to the phylogenetic interpretation of the Trochophore the author says: "If we assume as true that the Trochophora is the characteristic form of the Scolecida, Articulata, Tentaculata, and Mollusca, we have recognized a common body for all these groups. We may also assume a common descent, and state the law that the Zygoneura are derived from a common ancestral form, that has the Trochophora as a stage in the development. Further, we may ask the question whether the Trochophore is itself the repetition of an

ancestral form, and conclude that it is in the highest degree probable, inasmuch as we know several forms of animals which in their mature condition come very near to the Trochophore. Particularly is this true for the Rotifers. The little spherical Rotifer discovered by Semper in the Philippine Islands illustrates most fully this law; and it is to be marked that this is a typical Rotifer, and that at the same time many other Rotifers in spite of their changed outer form possess many true Trochophore characters. On the other hand, it has been affirmed that the Rotifers are sexually mature larvæ of higher forms, and this is not entirely impossible, but it must be remembered that there is no definite evidence for this hypothesis. It is further to be noted that the Turbellarians in their adult condition approach very near to the Protrochula, except that in the adult form ciliated bands are wanting. The view that the inner organization of the Protrochula and Trochophora repeat ancestral characters is made probable by the very similar relations of the organs of the Platodes to the Rotifers. But even the outer arrangement of cilia of the Trochophore may in all probability be considered as an ancestral character, since it is found to some extent not only in the Rotifers but in other groups as well,—viz., in the Entoprocta and the Tentaculata as definite structures in the adult organization.

"We may thus formulate the following law: The Protrochula is a repetition of the Protrochozoon,—*i.e.*, the common ancestral form of all Zygoneura. The Trochophora is the repetition of the Trochozoon, —*i.e.*, the common ancestor of all the Zygoneura standing above the Platodes. The organization of the Scolecida is referred directly back to the organs of the Protrochula and Trochophora. This applies to the nervous system, digestive tract, muscles, and the proto-nephridia, but not to the gonads, which appear primitively paired in the Scolecida, and have the structure of sac-gonads with peculiar excretory tubes. Concerning the development of these there are few observations, but it is probable that the sac-gonads and the gonad ducts (viz., egg-tubes and sperm-tubes) are of mesodermal origin, and represent cœlomatous formations.

"Kleinenberg has attempted to derive the Trochophore from the *Medusa form*, comparing the preoral ring nerve of the Annelid larva with the ring-nerve of the Hydromedusæ. This hypothesis is scarcely in accord with the rest of the organization. There is much better grounds for the belief that the Ctenophores stand very near to the Zygoneura. The sense-organ plate at the apical pole, the mesenchymatous musculature and the ectodermal œsophagus appear to be

related structures, also the ciliated apparatus of the Ctenophore may be compared with the preoral ciliated band of the Trochophora. We would assume that the cœlom sacs and nephridial canals of the Zygoneura (sac-gonads of the Scolecida) are derived from the gastric canals of the Ctenophores, and therefore that the mid-gut of all Zygoneura may be compared morphologically only with the central stomach of the Cœlenterates in general and the Ctenophores in particular, and not with the whole primitive digestive system of cœlenteric apparatus, as Lang has done."

ENTOMOLOGY.[1]

"**Biological Papers.**"—With this general title Prof. Charles Robertson, of Carlinville, Illinois, has recently distributed, under one cover, a series of admirable papers on flowers and insects, and descriptions of North America Hymenoptera. In his studies of the former subject the author has followed closely along the lines laid down by Müller in his "Fertilization of Flowers," describing the structural peculiarities of the blossom of each plant considered, and the relative time of development of each part, and cataloguing both the species of insect visitors and the object of their visit. The length of these catalogues indicates an amount of careful field work which will be best appreciated by those who have tried it.

Lepidoptera of Buffalo.—The last number of the Bulletin of the Buffalo Society of Natural History contains an excellent "List of Macro-Lepidoptera of Buffalo and Vicinity" by Edward P. Van Duzee. In its preparation the author has been assisted by Dr. D. S. Kellicott, Mr. A. H. Kilman, Mr. Philip Fisher, and other members of the society. The list includes the Geometridæ and Pyralidæ, but omits the Tortricidæ and Tineidæ. The total number of species is 777, of which 361 are Noctuidæ. The same issue of the Bulletin contains an account of "Mill's Collection of Fresh-Water Sponges," by Dr. Kellicott.

Kerosene Emulsion.—In Bulletin No. 16 of the Michigan Experiment Station Prof. A. J. Cook discusses "Kerosene Emulsion and Its Uses." The article is evidently the result of a large amount of careful experimentation of the highest practical value, in which the

[1] Edited by Prof. C. M. Weed, Hanover, N. H.

author has been assisted by Mr. G. C. Davis. Prof. Cook describes under separate headings three formulæ for preparing the emulsion : the first is his own method of making an emulsion of soft soap and kerosene ; the second, his method of making an emulsion of hard soap and kerosene ; and the third is the well-known Riley-Hubbard formula. For success with the latter the experiments here reported indicate that soft water must be used. Th authors believe the pyrethro-kerosene to be a valuable insecticide, and report experiments in which kerosene emulsion has been successfully used against vermin on domestic animals, rose chafers, hollyhock bugs (*Orthotylus delicatus* Uhle.), yellow-lined currant bugs (*Pœcilocapsus lineatus* Fab.), immature squash bugs, aphides, pear slugs, and pea weevils. The Bulletin is illustrated by eight original figures, and altogether is one of the most useful and interesting of recent station publications.

Host-Plants of Aphididæ.—Mr. T. A. Williams has lately published as Bulletin No. 1 from the Department of Entomology of the University of Nebraska a "Host-Plant Index of North American Aphididæ." There is a short introductory discussion of plant lice by Prof. Lawrence Bruner, after which follows a list of North American plants and the species of Aphides which attack them.

Prof. Smith on the Rose-Chafer.—Bulletin No. 82 of the New Jersey Experiment Station consists of an extended discussion of the rose-chafer or "rosebug" (*Macrodactylus subspinosus*) by Prof. J. B. Smith, who states that "this insect has done more injury during the few years last past than any one other species in the state of New Jersey, excepting, perhaps, the codling moth and plum curculio." The author gives under successive headings an account of its history in New Jersey, food habits, mouth parts, habits of the beetle and larva, breeding grounds, life history, and remedies. Under the latter heading he reports experiments showing that for practical purposes in a region where the insect is so abundant the following substances have little or no remedial value : the arsenites, copper mixtures, pyrethrum, kerosene, lime, tobacco, acetic acid, quassia, digitalis, corrosive sublimate, muriate of ammonia, cyanide of potassium, "odorless insecticide," sludgite, kainit, alum, and hot water. The latter substance, which has lately been recommended by the *Rural New Yorker* as a rosebug remedy, was found to kill the beetles at a temperature of 125°, but the difficulty of applying it successfully was so great, on account of the cooling caused by evaporation, that it proved a failure

in the field. Professor Smith has found mechanical devices for collecting the bettles the best way of fighting them, and expresses the belief that they can be successfully subdued in this way.

Heteroptera of Tennessee.—Professor Summers[2] has gotten together a very useful synopsis of the Heteroptera of Tennessee. It follows the general lines laid down in Comstock's discussion of this group in his "Introduction to Entomology" (a discussion, however, in which Professor Summers's aid is frequently acknowledged by the latter author), and is illustrated by 14 figures and one plate. Two pages are devoted to a general discussion of remedies.

Entomological Personals.—During the last few months a number of American entomologists have changed locations. Dr. J. C. Neal, of the Florida station, has resigned to take the directorship of the new Oklahoma Station at Stillwater. Mr. C. W. Woodworth has gone from Arkansas to California, where he is located at the experiment station at Berkeley. Mr. F. J. Niswander, assistant to Professor Cook at the Michigan Agricultural College, has gone to the University of Wyoming at Laramie. Mr. C. P. Gillette, of the Iowa station, has accepted the professorship of zoology and entomology at the Colorado Agricultural College, and Prof. Herbert Osborn has taken charge of the Iowa station work. Mr. A. B. Cordley has left the University of Vermont to become an assistant of the U. S. Division of Entomology. An appointment of peculiar fitness is that of Mr. Frank Benton to the apiarian work of the same division. Mr. Benton is a graduate of the Michigan Agricultural College, and has spent the last ten years in Cyprus and other eastern countries studying and experimenting with bees. Dr. Riley has also arranged for other apicultural work by appointing Professor A. J. Cook and Mr. W. R. Larrabee field agents of the division. Mr. C. H. Tyler Townsend has left Washington to accept a chair at the New Mexico Agricultural College. Mr. F. M. Webster has gone from Indiana to the Ohio station at Columbus, where he is consulting entomologist, taking the place vacated by the editor of this department when he went to the New Hampshire State College. A foreign change that is worthy of notice is that of Professor T. Thorell, the veteran arachnologist, from Sori, Italy, to Montpelier, France.

Outlines of Entomology.—Miss Murtfeldt is to be congratulated on the admirable way in which she has gotten together an intro-

[2] The True Bugs, or Heteroptera, of Tennessee. By H. E. Summers, Consulting Entomologist. Bull. Tenn. Exp. Station, Vol. IV., No. 3, July, 1891, pp. 31.

ductory discussion of insect classification.[3] She has divided her work into thirty-one chapters, the first five of which deal with the external structures of insects and their transformations. Then the orders and suborders are taken up in regular sequence, and their characters clearly and concisely defined. We are glad to learn that the author intends to have these "Outlines" published in book form for school purposes.

Recent Bulletins.—Mr. F. M. Webster begins his work at the Ohio station by a timely discussion of the Wheat Midge, *Diplosis tritici* (Bulletin, Vol. IV., No. 5, September, 1891). This pest has appeared in Central Ohio in considerable numbers.——Professor F. J. Niswander discusses plant lice in a five-page Bulletin (No. 2) issued by the Wyoming station in August.——In Bulletin No 3 of the New Mexico station Professor C. H. Tyler Townsend discusses a number of fruit insects.——In the report of the Maine station for 1890 Professor F. L. Harvey gives a popular account of a number of injurious insects which have attracted attention during the year.——Professor J. B. Smith's account of his year's work in the 1890 report the New Jersey station contains many results of great practical value.

MICROSCOPY.[1]

Methods of Preserving Human Embryos.—It frequently happens that human embryos which come into my possession are almost ruined by the physician's carelessness in preserving the material. For instance, I have obtained specimens simply placed in water, a solution of policylic acid, strong alcohol, or simply packed in cotton or even forced into a small bottle. Any of these methods almost totally spoil the specimen for careful study.

An abundance of material comes into the hands of the physician, and through his kindness it becomes possible to throw as much light on human embryology as on that of any of the other mammals. During the last few years several embryologists, especially Prof. His, have not only added a great deal to our knowledge of human embryology, but

[3] Outlines of Entomology. Prepared for the use of farmers and horticulturists. By Mary E. Murtfeldt. Report of the Missouri State Horticultural Society for 1890. Also issued separately, pp. 130, Figs. 48.

[1] Edited by C. O. Whitman, Clark University.

to vertebrate embryology in general, by the careful study of a few human embryos. Only a glance at the new edition of Quain's "Anatomy" will convince any one of this fact.

Of a dozen human embryos, less than six months old, which have come into my possession during the last few years, only one has been found well preserved and suited for careful study. For this reason I address this note especially to those who in the future will be kind enough to send me material.

In cases of early abortion the physician that attends pays no attention whatever to the embryo, or only preserves it carelessly in alcohol. Often it is impossible to find the embryo within the blood and particles which are extruded. If in all these cases the suspected material were, without previous examination, placed simply in seventy per cent. alcohol, most valuable specimens would often be obtained. When the ovum comes away unruptured, it nearly always ruins the specimen to examine it. It should be placed at once in a large quantity of Müller's fluid, or in alcohol. If these are not at hand the ovum should be kept temporarily in a large open-mouthed bottle until the hardening fluid can be obtained. The specimen, even if not opened, can be injured very easily by handling or by wrapping it with cotton or cloth. In all these cases it is not advisable to throw injured specimens away, for poor material is of value for dissection, and certainly is better than none at all.

Gynecologists, who are more especially interested in this subject, frequently have beautiful collections of specimens, and are by no means inclined to part with them. Yet the advancement of embryology has shown that it is necessary to destroy, or rather to lay into sections, the embryos before they can be studied properly. After a good specimen is once sectioned, the whole embryo or any part of it can be modeled quite easily on a large scale. This is necessary before the parts can be studied properly, and it requires a great deal of time and a considerable amount of costly apparatus. For this reason the embryologist feels justified in asking the gynecologist to part with his highly prized material.

Those physicians who have small laboratories, and are acquainted with the ordinary technique of hardening, should by all means harden specimens in Perenyi's chromonitric acid, in Kleinenberg's alcoholic picrosulphuric acid, in ten per cent. nitric acid, or in saturated solution of corrosive sublimate. Others who are not familiar with the above technique should use Müller's fluid or seventy per cent. alcohol. The latter is in general the best, and an amount of the alcohol equal

to at least five times the volume of the specimen should be used. When a specimen is to be transported by mail or express it should be transferred to a smaller bottle of alcohol of the same strength, and a very small *loose* cotton plug placed both above and below it.—F. MALL, *Clark University*.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The National Academy of Sciences met in New York at Columbia College from November 10th to 12th, inclusive. The following papers were read: Some Aspects of Australian Vegetation; G. L. Goodale. The Nomenclature of Vegetable Histology; G. L. Goodale. On Certain New Methods and Results in Optics; Charles S. Hastings. An Exhibition of the New Pendulum Apparatus of the U. S. Coast and Geodetic Survey, with Some Results of Its Use; T. C. Mendenhall. On the Use of a Free Pendulum as a Time Standard; T. C. Mendenhall. On Degenerate Types of Scapula, and Pelvic Arches in the Lacertilla; E. D. Cope. The Proteids or Albuminoids of the Oat-Kernel (second paper); Thomas B. Osborne. Astronomical Methods of Determining the Curvature of Space; C. S. Peirce. On Geographical Variation Among North American Birds, Considered in Relation to the Peculiar Intergradation of *Colaptes auratus* and *C. cafer*; J. A. Allen. On the Variation of Latitude; S. C. Chandler. The Tertiary Rhynchitidæ of the United States; Samuel H. Scudder. On a Color System; O. N. Rood. Preliminary Notice of the Reduction of Rutherfurd's Photographs; J. K. Rees. On the Application of Spectrum Analysis to the Analysis of the Rare Earths, and a New Method for the Preparation of Pure Yttrium; H. A. Rowland. A Nomenclator of the Families of Fishes; Theodore Gill. Measurement of Jupiter's Satellites by Interference; A. A. Michelson. The Follicle Cells of Salpa; W. K. Brooks. The academy was entertained on the evening of the 10th by President Low, of Columbia College; and on that of the 11th by Mrs. Henry Draper. A part of the latter entertainment consisted of an illustrated lecture by Prof. E. C. Pickering on the work of the Draper memorial fund in astronomical research in South America.

Biological Society of Washington.—*October 17th.*—The following communications were made: Food Plants of the Indians of the Death Valley Region; Frederick V. Coville. Notes on Paleopathol-

ogy, R. W. Shufeldt. The Fate of the Fur Seal in American Waters (with lantern illustrations); William Palmer.

October 31st.—The Classification of the Tetrodontoidea; Theodore Gill. Some Fishes New to New England Waters; T. H. Bean. Cuckoo Stomachs and Their Contents; Walter B. Barrows. The Temperature of Trees; N. H. Egleston. Notes on Parasites: Development of *Echinorhynchus gigas;* C. W. Stiles.

November 14th.—Winter Aspects of the Mojave Deseet Region; T. S. Palmer. A Case of Echinococcus in Swine; V. A. Moore. Notes on Parasites: *Coccidium bigeminum* Stiles; C. W. Stiles. Haeckel's Radiolaria of the Challenger Expedition; L. F. Ward. Three Days in the Tropics; L. F. Ward.—FREDERICK A. LUCAS, *Secretary.*

Boston Society of Natural History.—*November 4th.*—The following pap.rs were read: The Natural History Museums of Australasia; G. L. Goodale. Recent Fossils of the Harbor and Back Bay, Boston; Warren Upham.—SAMUEL HENSHAW, *Secretary.*

SCIENTIFIC NEWS.

The Princeton University Geological Expedition under Prof. W. B. Scott has returned with much valuable booty. They explored the valley of Deep River, Montana, where the Ticholeptus beds are seen, and obtained a good series of the vertebrate species described from those beds by Cope, together with some additional ones. Prof. Scott finds three horizons of fossils in the valley, one of which at least is Loup Fork, while the lowest one is nearly allied to the John Day bed.

The expedition on behalf of the American Museum of Natural History, of New York, under direction of Dr. J. L. Wortman, explored the Wind River and Big Horn Eocene regions in Wyoming, the past summer. Dr. Wortman was very successful, and we shall have considerable new information respecting the interesting faunæ which these beds contain in the forthcoming report on them by Prof. Osborn and Dr. Wortman.

Prof. H. F. Osborn has accepted the position of Professor of Biology in Columbia College, New York.

Prof. Frederick Starr has accepted the chair of ethnology and archeology in the Rockefeller University of Chicago.

Prof. C. H. Gilbert is Professor of Vertebrate Biology in the Leland Stanford University of California.

The December number of the *North American Review* will contain a symposium on The Quorum in European Legislatures, apropos of the probable renewal of the Speakership controversy on the assembling of Congress, December 7. This contribution will include statements as to European usages, in reference to the point at issue, by M. Louis Ruchonnet, President of the Swiss Confederation; Herr Von Levetzow, President of the German Reichstag; M. Henri Brisson, ex-President of the Chamber of Deputies; M. Jules Meline, ex-Minister of Agriculture; M. Sofus Hogsbro, President of the Danish Folkething; Sig. Chiavassa of the Italian Senate, and others. The same number will also contain The Three Philanthropists, by Colonel R. G. Ingersoll; The Benefits of War, by Admiral Luce; A Great Statistical Investigation, by Carroll D. Wright, and Railway Rates, by General Horace Porter. Further contributions will appear in the same number from Signor Crispi, ex-Prime Minister of Italy; the Dean of St. Paul's Cathedral, London; T. V. Powderly, and Prof. James Bryce, author of The American Commonwealth.

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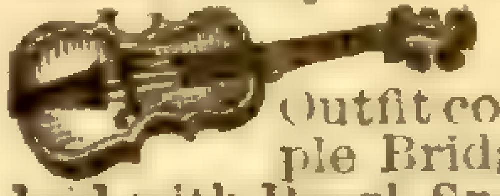

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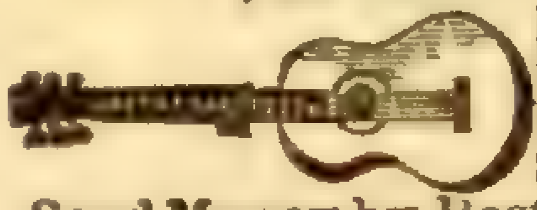

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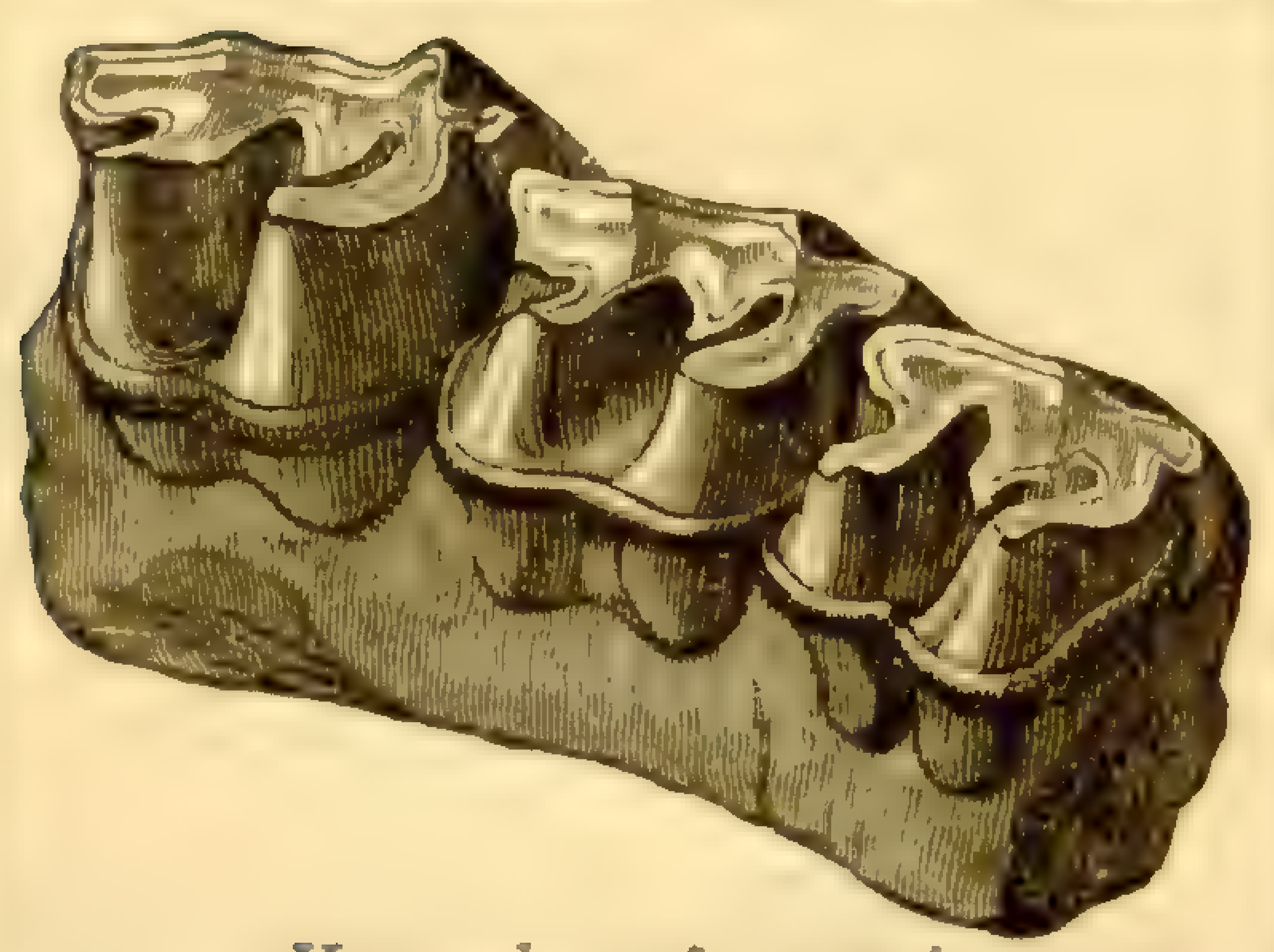

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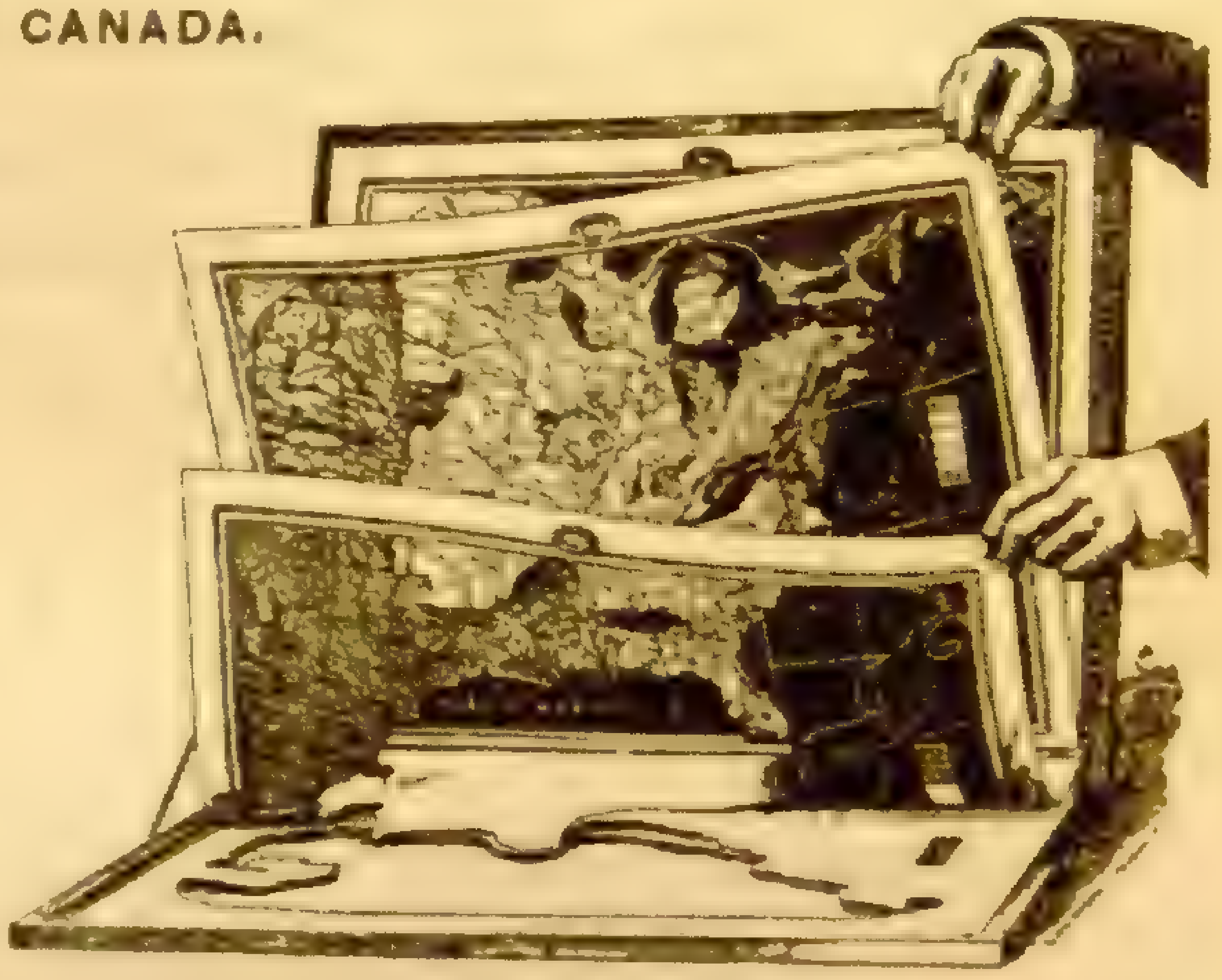

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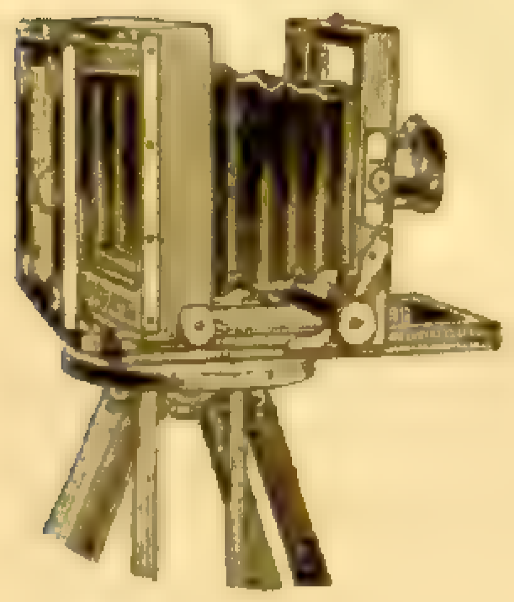

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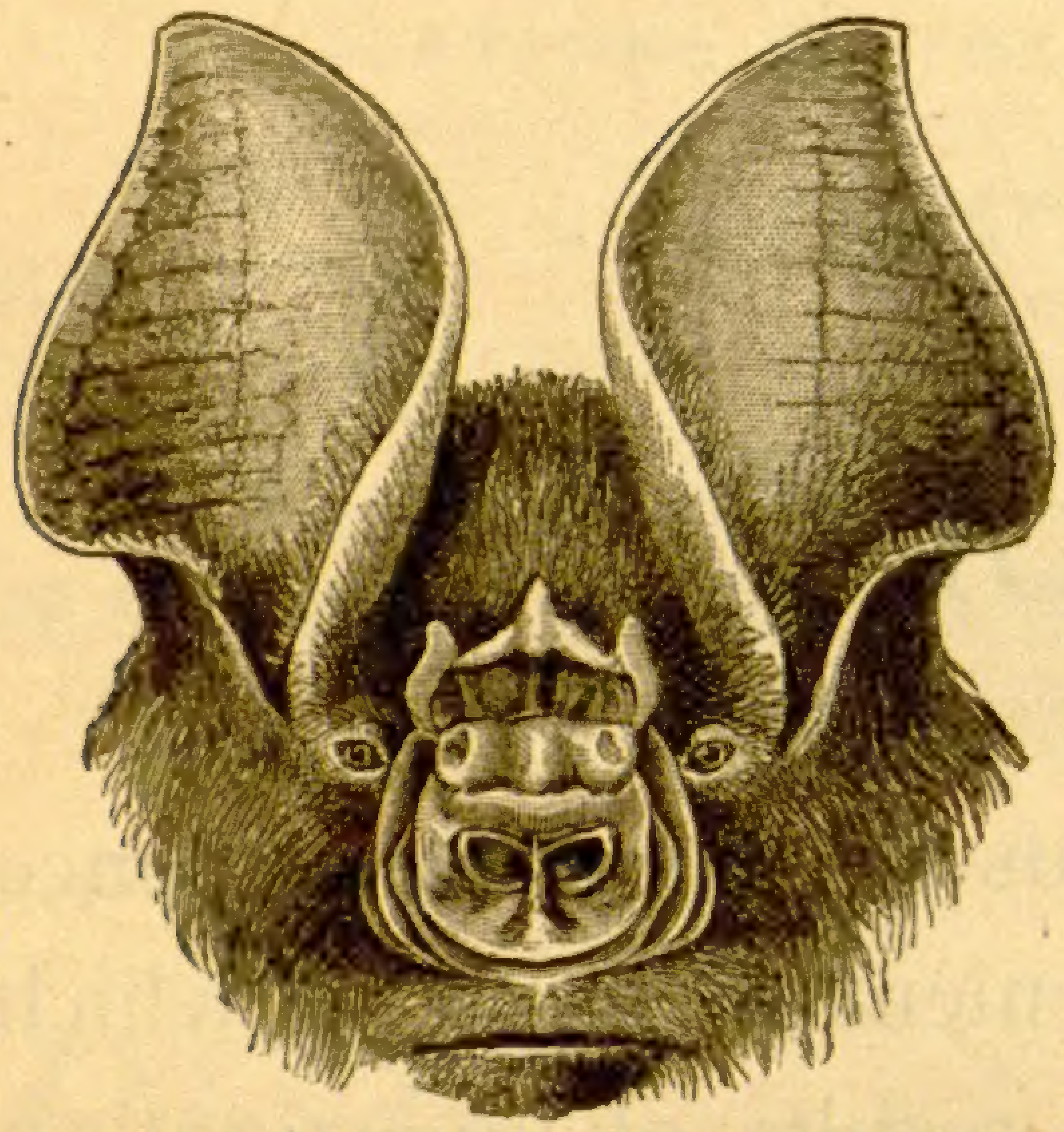

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